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Technical Memorandum

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VOLUME D: DATA AND ANALYSIS

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This report (Volume D of TG 1298) documents the data that were recorded and the analyses that were performed in conjunction with an experiment conducted by The Johns Hopkins University Applied Physics Laboratory for the U.S. Air Force and the Defense Advanced Research Projects Agency to determine the validity of one facet of the theory of groundwave propagation at 100 kHz. Volume A is the summary report, Volume B describes test operations, and Volume C describes the measurement system.

This goal of the experiment was to determine if an analytic function could be developed for operational use that relates secondary phase factor to envelope to cycle difference so that geodetic position can be computed, accurately and in real time, from Loran-C coordinates. Field test data were collected and analyzed. They show trends that tend to support the hypothesis that the desired functional relationship exists, at least under certain conditions. Additional analysis and perhaps tests will be necessary to define these conditions or to prove conclusively the existence of such a relationship.

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1. INTRODUCTION

The Applied Physics Laboratory (APL) has conducted an experiment for the U.S. Air Force (USAF) and the Defense Advanced Research Projects Agency (DARPA) to determine the validity of one facet of the theory of groundwave propagation at 100 kHz. The theory indicates that, if proper account is taken of group and phase velocities in the propagation of pulses of the Loran-C radionavigation service, geodetic position should be computable using the vacuum speed of light and the times of arrival of the pulse and the carrier. Specifically, the test goal was to determine if an analytic function can be developed for operational use that relates secondary phase factor (SPF) to envelope-to-cycle difference (ECD) so that geodetic position can be computed accurately and in real time.

Test data were obtained in the eastern United States using the East Coast Loran-C chain and two identical measurement systems, one in a mobile test van and the other at a fixed site at the U.S. Naval Observatory (NAVOBSY). The van occupied 10 field sites during the course of the test. APL was assisted in this test by NAVOBSY and the Defense Mapping Agency Topographic Center (DMATC). The positions of all sites were precisely surveyed by DMATC using the Navy Navigation Satellite System. The sites are on ray paths from Loran-C stations through NAVOBSY. A team from NAVOBSY executed time transfers to each field site during the collection of loran data. The collected data include very accurate measurements of the Loran-C signal voltage and the absolute time at which they were made at each of the 10 pairs of sites.

The test operations, including site selection and surveys, acquisition of Loran-C and time transfer data, and a Loran-C receiver response test, were initiated in April 1974 and completed in November 1975. This report (Volume D of TG 1298) documents the data, its analysis, and findings. Volume A is the summary report, Volume B describes the test operations, and Volume C describes the measurement system. All volumes are written under the assumption that the reader is reasonably familiar with the Loran-C system of radionavigation. Reference 1 is suggested reading for those who are not.

As a result of extensive data analysis, it was possible to establish statistically significant measures of SPF and ECD for each of the 12 tests conducted at the field sites and at NAVOBSY. The voltage measurements were used also to isolate the modulations of the carrier that give the pulses from the Carolina Beach, Dana, and Nantucket Stations their unique characteristics. The pulses from each station contain both in-phase and in-quadrature modulations of the carrier that make it impossible to make direct observations of the carrier. Largely because of this, the functional relationship between ECD and SPF that, it was hoped, would be derived from the data is presently not well defined. However, trends are observed in the data that tend to support the hypothesis that the desired functional relationship exists, at least under certain conditions. Additional analysis and perhaps tests will be necessary to define these conditions or to prove conclusively the existence of such a relationship.

2. OVERVIEW

Volume D of TG 1298 describes the processes that were applied to the portion of the field data that pertains to the primary goal of the experiment. It also records the processed data, a number of intermediate results, and findings regarding the attainment of the goal. We have chosen not to publish the raw field data and the rather voluminous computer output that was generated in developing an understanding of the data and their statistical characteristics.

The field data are recorded on approximately 100 10-in. reels of magnetic tape and will be stored indefinitely. Some of the reels of tape contain recordings of ancillary data. From one set of these data, the time difference coordinates of the satellite survey monuments at the various field sites could be determined. A second set was recorded to quantify any diurnal effect on Loran-C emissions. The ancillary data have not been processed, and at the present time there are no plans to do so.

The complete report is in four volumes. Volume A is a summary report that touches on all aspects of the experiment. It includes excerpts from this volume and discusses the findings of the experiment. Volume B describes test operations, and Volume C is a description of the measurement systems used to gather data. Volume D starts at the point in the experiment where all the observations of the Loran-C signals, along with other pertinent information, are available as recordings on magnetic tape.

If the reader wishes to understand this volume in relation to the complete experiment, it is suggested that Volume A should be read first. Otherwise, the reader will be exposed only to the collected data, its processing, and analysis.

3. DISCUSSION

RECORDED DATA

The data recorded on the magnetic tape are identified in Table 1. These data were recorded in blocks that were limited in size to 512 8-bit words (bytes). The format within each block is shown in Fig. 1.

The analog to digital (A to D) converters were adjusted such that 1 V produced the largest binary output number, i.e., 2 to the 13th power minus 1. Since each voltage measurement consisted of 13 bits plus a sign bit, two bytes were required for each measurement.

The locations of the voltage measurements on the Loran-C pulse are shown in Fig. 2. The odd-numbered measurements are shown as "x" bits and the even as "y" bits in Fig. 1. The block size accommodated all the voltage measurements on seven pulses, the Universal Time Coordinated (UTC) time of the first x sample in the block, and all the "header" data read from the Interface Unit (IU) of the measurement system. Four hundred seventy-seven bytes were used in each block.

The locations of the field sites and the days on which data were taken are given in Table 2. The exact geodetic positions of the survey monuments over which the antenna was placed at each field site and NAVOBSY are given in Volume B. At each field site and simultaneously at NAVOBSY, primary data were recorded on the magnetic tape in three files, each containing a 20-min segment of the data. The first file was started at 3:30 PM, the second at 3:51 PM, and the third at 4:12 PM EDT. No changes were made among recordings other than to indicate, if necessary, a change in the temperature of other environmental conditions on the IU control panel. Recordings of primary data were made with the voltage sample points located in time as shown in Fig. 2, with two exceptions. At Marietta, OH, the back side of the antenna was inadvertently pointed toward the Dana Station, and the voltage measurements were made 5 μs later than shown in Fig. 2. Later measurements made specifically for the purpose (5 μs earlier than shown in Fig. 2) showed that the effect of reverse pointing was limited to an inversion of the phase.

Table 1

Taped Data

Parameter	Digits/Bits	Units
Voltage at Odd Samples, x	13 bits + sign	V
Voltage at Even Samples, y	13 bits + sign	V
Attenuation	2 digits	dB
Time	13 digits	h, min, 10^{-7} s
Day Number	3 digits	-
Year	1 digit	-
Group Repetition Interval	3 digits	10^{-4} s
Station Code	1 digit	-
Site Code	2 digits	-
Weather Code	2 digits	-
Atmospheric Pressure	5 digits	10^{-3} in. Hg
Wet Bulb Temperature	3 digits	10^{-1} °C
Dry Bulb Temperature (outside)	3 digits	10^{-1} °C
Dry Bulb Temperature (inside)	3 digits	10^{-1} °C
Data Recording Mode	1 digit	-
Predicted Time Calibration	9 digits + sign	10^{-9} s
Note Code	1 digit	-

Byte	MSB	LSB	(most/least significant bit)
1	± ± ± x	x x x x	
2	x x x x	x x x x	
3	± ± ± y	y y y y	(112 pairs of x, y samples, 7 GRI's, in 2's complement binary)
4	y y y y	↓ y y y y	
	± ± ± y	y y y y	
448	y y y y	y y y y	
449	Hour (10^{1})	Hour (10^{0})	
	Minute (10^{1})	Minute (10^{0})	
	Second (10^{1})	Second (10^{0})	
	Second (10^{-1})	Second (10^{-2})	UTC time of first x sample in block)
	Second (10^{-3})	Second (10^{-4})	
	Second (10^{-5})	Second (10^{-6})	
455	Second (10^{-7})	--	
	--	Atten. (10^{1})	
	Atten. (10^{0})	PTC (±)	
	PTC (10^{-1})	PTC (10^{-2})	
	PTC (10^{-3})	PTC (10^{-4})	(PTC = predicted time calibration)
460	PTC (10^{-5})	PTC (10^{-6})	
	PTC (10^{-7})	PTC (10^{-8})	
	PTC (10^{-9})	Day (10^{2})	
	Day (10^{1})	Day (10^{0})	
	Year	Xmitter	
	Mode	Site (10^{1})	
	Site (10^{0})	Wx (10^{1})	(Wx = weather code)
	Wx (10^{0})	Note	
	DBTI (10^{1})	DBTI (10^{0})	(DBTI = inside dry bulb temperature)
	DBTI (10^{-1})	WBT (10^{1})	(WBT = wet bulb temperature)
470	WBT (10^{0})	WBT (10^{-1})	(DBT = outside dry bulb temperature)
	DBT (10^{1})	DBT (10^{0})	
	DBT (10^{-1})	BARO (10^{1})	
	BARO (10^{0})	BARO (10^{-1})	(BARO = barometric pressure)
	BARO (10^{-2})	BARO (10^{-3})	
475	--	GRI (10^{-1})	
	GRI (10^{-2})	GRI (10^{-3})	
	GRI (10^{-4})		(-- = zero-filled characters)
	--	--	
512	↓	↓	

Fig. 1 Raw Data Tape Format for Each Block of Recording

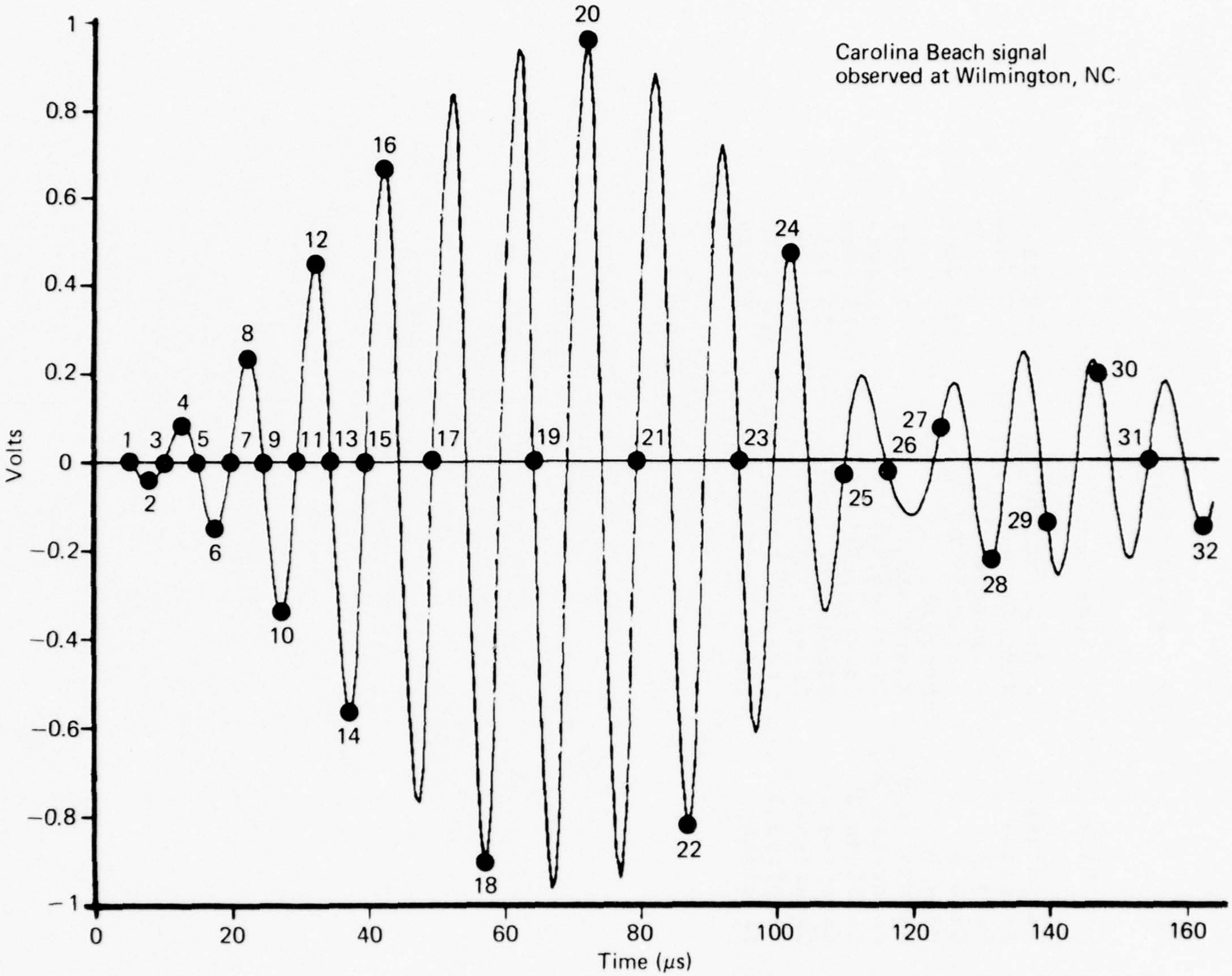


Fig. 2 Typical Loran-C Pulse Showing the Location of Sample Points

Table 2

Test Field Sites Visited

Site	Location	Test Date (1975)
Nantucket 1	Toms River, NJ	29 May
Baseline	NAVOBSY, DC	3 June
Dana 3	Georgetown, DE	5 June
Dana 2	Marietta, OH	10 June
Dana 1	Danville, IN	12 June
Nantucket 3	Bluefield, WV	17 June
Nantucket 2	Grottoes, VA	19 June
Carolina 2	Emporia, VA	24 June
Carolina 1	Wilmington, NC	26 June
Carolina 4	Dexter, NY	30 June
Carolina 3	Towanda, PA	2 July
Baseline	NAVOBSY, DC	7 July

During each recording session at each field site and at NAVOBSY, calibration data were also recorded in separate files on the tape. These data showed that the measurement systems retained their calibrations throughout the test. The calibration method is discussed in Volume B.

DATA PROCESSING

Refer to Fig. 3. The format of the data recorded on the tapes labeled "Field Site" and "Fixed Site" is shown in Fig. 1. The data from both of these tapes, together with job control cards, were subjected to preprocessing immediately upon the return of the tapes to the Laboratory on data-taking days (see Volume B). The preprocessor disregarded all voltage measurements over 1 V (first-stage editing). Its printed output consisted of the means and standard deviations of groups of 50 contiguous pulses and the grand means and standard deviations of the voltage measurements on all the pulses accepted from each 20-min segment of data. The data taken during calibration recordings were processed in the same way as those for pulses. The printed output of the preprocessor was used to assess the quality of the data prior to moving to the next site. The output also included a condensed data tape containing these grand means and standard deviations, as well as all the acceptable pulse data in a revised format. A deck of punched cards was also produced that recorded an editing criterion, taken to be twice the average of the standard deviations at each sample point along the pulse for use in further editing of the data. The second-stage editor rejected all the data for any pulse if any voltage sample of that pulse deviated from the mean by more than the editing criterion. The printed output of the second-stage editor was the same as that out of the preprocessor. The punched card output recorded the means of the accepted voltage samples taken during each 20-min data segment.

The processing shown in Fig. 3 up to the tape of condensed data was done in two stages on the IBM 360/91 computer. In the first stage, the first 16 voltage samples of the pulse were processed; in the second stage, the last 16. The computer programs for the data processing are documented in Appendix A.

There is one reel of tape of condensed data for each site and one for each recording of baseline data. There are 12 files of data on each of these tapes.

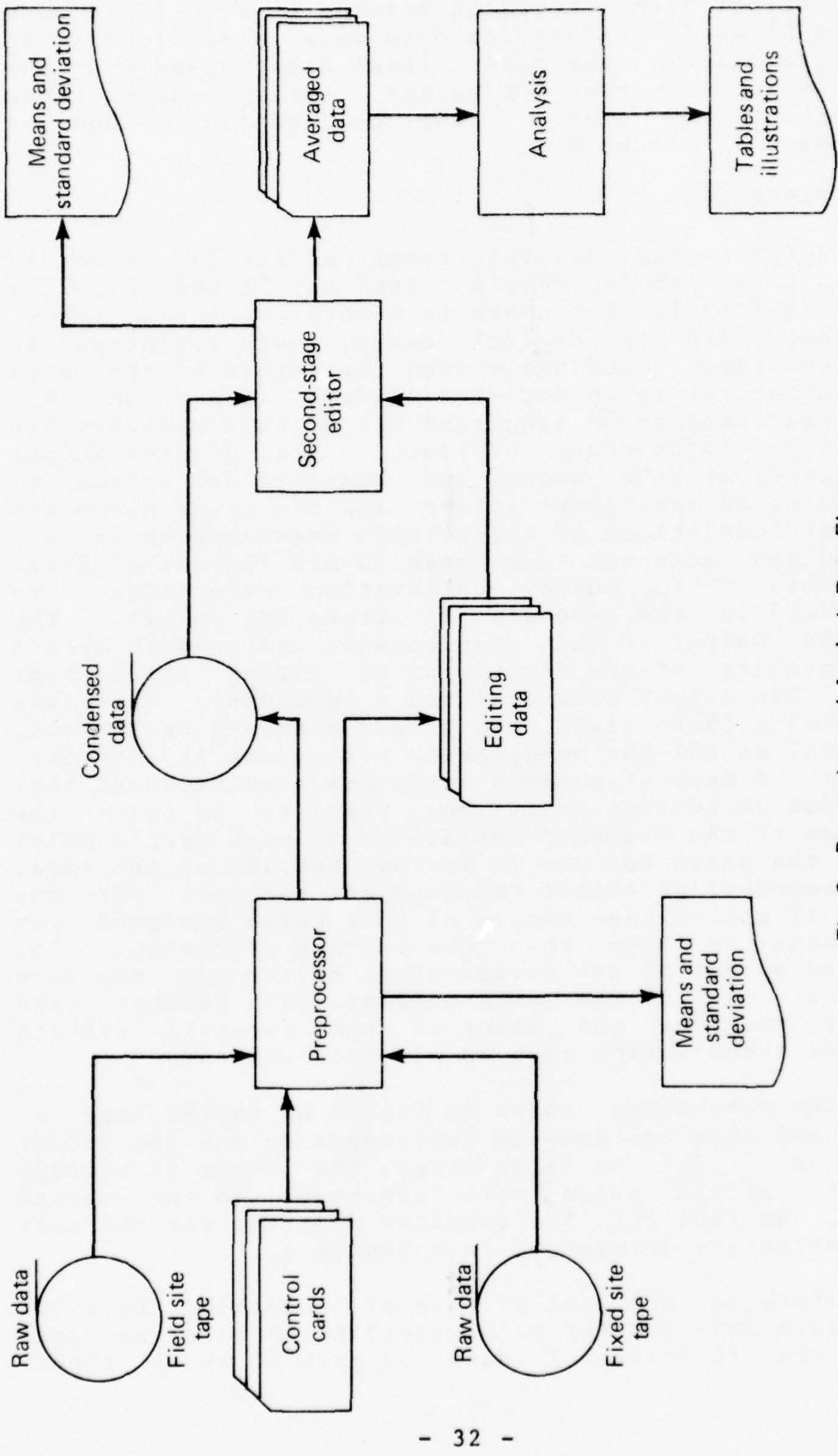


Fig. 3 Processing and Analysis Data Flow

Files 1 through 6 contain all the edited data for sample points 1 through 16, and files 7 through 12 for sample points 17 through 32. Files 1, 2, and 3 and 7, 8, and 9 contain 20-min segments of data recorded at NAVOBSY; files 4, 5, and 6 and 10, 11, and 12 contain the simultaneous recordings at the field site. Each file is organized into a succession of records. The first record is the header data, i.e., the data recorded from the front panel of the IU (see Volumes B and C). There are as many more records as there are pulses that survived first-stage editing. Each of these records contains the following data in the order mentioned: the UTC of the first voltage sample in the record, 16 mean voltages, 16 standard deviations of these voltages, and 800 voltage measurements, i.e., 16 measurements on 50 pulses. The preprocessor, in organizing the condensed data, correlated the time of sampling each pulse so that samples with the same index number on corresponding records for NAVOBSY and the field site are samples of the same pulse. This requires that both records be of the same length. This was done by making the field site data record the same length as NAVOBSY, either by truncating it or filling it with obviously false data (flags). Subsequently, the second-stage editor recognized these flags and processed only those data for which there were two observations of the same pulse.

ANALYSIS

Reduced Data

Analysis of the experimental results was performed on the mean values of voltage measured during each 20-min segment of data. These are the mean voltages recorded on the punched card output of the second-stage editor (Fig. 3). Appendix B contains a table of these data (Table B-1). Also included in Table B-1 are "Other Data," namely, the date, the time of the first data record in each 20-min segment, the difference in UTC time between NAVOBSY and the field site, the distance from the transmitting station to the recording site, and the attenuation setting of the attenuator (see Volume B). Appendix B also includes a table of the signal-to-noise ratios computed on a per-pulse basis for the first segment of data. These signal-to-noise ratios are indicative of the quality of edited data.

Polynomial Fits

The first step in the analysis was polynomial fitting of the mean voltages. The times of the voltage measurements along the pulse were very accurately timed at 2.5- and 7.5-μs intervals in synchronism with the output of the cesium standards. The odd- and even-numbered voltage measurements, therefore, are exactly in quadrature to each other when sampling a 100-kHz signal. To sample a loran pulse, the odd-numbered samples were taken near zero crossings, and the even near the peaks, i.e., in phase. In anticipation of the advantages of such orthogonality, the mean in-phase (I) voltages were fitted separately from the mean quadrature (Q) voltages. Although most difficult to confirm experimentally, it is assumed that the loran pulse starts with zero voltage and zero slope. To accommodate this assumption, it was decided to fit the I and Q mean voltages with polynomials with the coefficients of the first two terms (ascending order of degree) set to zero. After considerable experimentation, it was found that 10th degree polynomials fitted the mean voltages such that the maximum residuals were the same order of magnitude as the standard deviation of the voltages themselves. Because of the constraint imposed on the first two coefficients, these fittings required an iterative procedure to determine the difference in time between the time reference of the voltage samples and the start of the polynomials. Then, to realign the sample points in time, the polynomials were translated by this difference in time. The first two coefficients of the resulting polynomials are no longer zero. These polynomials were judged to be adequate representations of the measured data for use in later illustrations of the pulses and subsequent analyses. The computer program used for the polynomial fits is listed in Appendix C. The coefficients of all the fitted polynomials are presented in Appendix D.

Carrier Modulations and Pulse Shape

Initial plots of the I and Q polynomials indicated that the quadrature component was quite substantial in all of the observations. Since this could have been the result of misalignment between the zero crossings in the pulse and the Q (odd-numbered) sample points, the I and Q polynomials were jointly manipulated to determine whether or not there was a position on the pulse for the sample points where all the Q voltages would be zero. This was done by developing an analytic solution for the sample point locations for which the energy in the quadrature component of the pulse was a minimum. The algebraic development of this solution, as well as the computer program to execute it, are described in Appendix C.

Appendix E contains plots of the I and Q components of the signal after adjustment for minimum energy in Q between 10 and 70 μs. Since the I and Q components are orthogonal at the 100-kHz frequency of the Loran-C carrier, the I component can be considered to be the modulation of the sine of the carrier, and Q the modulation of the cosine of the carrier; that is,

$$V(t-t0)=I(t-t0)\sin(\omega(t-t0)+\phi)+Q(t-t0)\cos(\omega(t-t0)+\phi), \quad (1)$$

where V is the signal voltage,
t is the time,
$t0$ is the reference time,
$I(t-t0)$ is the I polynomial,
$Q(t-t0)$ is the Q polynomial,
ω is the angular frequency corresponding to 100 kHz, and
ϕ is the phase angle measured at t0.

The shape of the pulse envelope was computed as the square root of the sum of the squares of voltages evaluated from the I and Q polynomials (see Appendix C). The envelope shapes are shown in Appendix E.

The Correction Function

The envelope shapes of Appendix E are presented in such a way that a comparison can be made between the shapes observed at the field sites and the shapes observed simultaneously at NAVOBSY. The purpose of these comparisons was to disclose the differences between observations of the pulses at the field sites and at NAVOBSY, and to quantify the difference in pulse arrival times by one number, which we called ECM (envelope-to-cycle measure).

An inspection of the envelope shapes presented in Appendix E indicates that ECM is many-valued; that is, it depends on the location on the pulse where the time comparison is made. This is a consequence of very complicated propagation effects acting on both the sine and cosine components of the signal. It was decided, therefore, that ECM would be evaluated as it would be in a receiver that was perfectly phase tracking the Loran-C signal at the standard track point, that is, at the zero crossing at the end of the third cycle in the pulse, and also had the capability of measuring the envelope voltage at the same time as the phase track point.

The inferred locations of the zero crossings computed using Eq. (1) are presented in Tables F-1 and F-2 in Appendix F. Note that none of the zero crossings are 5 μs apart, as they would be if the carrier were only amplitude modulated. Note also in these tables that the zero crossing at the end of the third cycle is not at 30 μs under the condition of minimum energy in Q(t) over the leading edge. To align the standard track point of all the observed pulses at 30 μs, energy was shifted from I(t) to Q(t) such that the fractional parts of the "30.xxx-μs" columns of Tables F-1 and F-2 were removed (to about three decimal places). Using these revised polynomials for I(t) and Q(t), the zero crossings were recomputed using Eq. (1), and the pulse envelope shapes were also recomputed (see Appendix C for computing programs). These zero crossings are presented in Tables F-3 and F-4. Appendix F also presents expanded views of the leading edges of the envelopes as they appear, having aligned the standard track points at 30 μs.

An inspection of Figs. F-1 through F-12 indicates that the repositioning of the zero crossings does not resolve the problem of multivalued ECM. We continued, therefore, to approach the problem as our hypothetical receiver would. ECM was computed relative to NAVOBSY by computing the voltage difference between the field site and NAVOBSY observations and converting this voltage to time using the average slope of the two envelopes at 30 μs. The resulting values of ECM are presented in Table F-3.

SPF has usually been defined as it pertains to the propagation of a 100-kHz continuous wave (CW) groundwave. Since the 100-kHz carrier cannot be observed in pulses when they are transmitted with cosine modulation, this definition lacks application to the problem at hand (see Volume A for further discussion on this point). Therefore, we are faced with a new concept, namely, a secondary phase measure (SPM) defined with respect to the arrival time of the standard third-cycle zero crossing as follows:

$$SPM = (D/C) - T3, \tag{2}$$

where D is the distance over which the loran pulse propagates,
C is the vacuum speed of light, and
T3 is the time of arrival of the zero crossing at the end of the third cycle.

The vacuum speed of light used in computations was 299 792 456.2 m/s. The distance, D, and the time of arrival, T3, are computed from the basic data relative to their values that apply at NAVOBSY. The values of D and T3 used in Eq. (2) and the resulting values of SPM are included in Table F-3 of Appendix F. The value of T3 was computed as follows:

$$T3 = BTV - BTO - \Delta T + \Delta\Delta T, \tag{3}$$

where BTV is the block time at the field site, i.e., the time of the first voltage sample in a 20-min data segment,
BTO is the block time at NAVOBSY,
ΔT is the time transfer result, and
$\Delta\Delta T$ is the difference in time adjustments, computed relative to NAVOBSY, required to align all the standard third-cycle tracking points at 30 μs.

The values of BTV, BTO, and ΔT are tabulated as part of Table B-1 of Appendix B. The value of $\Delta\Delta T$ is obtained as an output of the computer programs used to align the standard third-cycle zero crossings.

The values computed for SPM are plotted against ECM in Fig. F-13 of Appendix F and in Fig. 26 of Volume A. This figure is a representation of the correction function that was sought as the principal goal of the experiment. SPM is plotted against distance from NAVOBSY in Fig. F-14, and ECM against distance from NAVOBSY in Fig. F-15. The attenuation of the signal is plotted against distance from the transmitters in Fig. F-16 of Appendix F and in Fig. 27 of Volume A. The significance of Figs. F-13 and F-16 is discussed in Volume A.

Frequency Filtering

As noted in Volume A, Fig. F-13 tends to describe a low-order functional relationship between SPM and ECM for only four of the twelve possible triads of points plotted in Fig. F-13. These four are connected by a straight line in Fig. F-13. In an attempt to understand why the remaining points appear to be in disarray, histograms were plotted initially of the data taken at NAVOBSY and simultaneously at Danville, IN, during the first 20-min recording. These histograms are shown in Appendix G as Figs. G-1 and G-2, respectively. Contours of equal frequency of occurrence are reasonably circular and concentric in Fig. G-2, indicating that the dominant interference is random. The marginal distributions are reasonably normal. This is not true in Fig. G-1. The inclined barbell contours indicate the presence of an interference that bears a coherent relationship with the loran signal. The distribution is double humped in spite of the fact that the marginal distributions are reasonably normal.

The recorded data were then subjected to a Fourier analysis to identify the coherent interference, if any, and to subsequently remove it. The results of the Fourier analysis are shown in Figs. G-3 through G-6 in Appendix G. Each point plotted in these figures is the sum of the squares of 16 adjacent Fourier coefficients. The plots, therefore, display the power spectral density at reduced frequency resolution. Figure G-3 is the power spectral density of the quadrature data, and Fig. G-4, the in-phase data, taken at NAVOBSY. Figures G-5 and G-6 show the power spectral densities for the simultaneous Danville, IN, data. Note that at Danville, IN, there is an interference at frequency number 124 and at NAVOBSY at frequency number 154. These interferences were removed by detecting those frequencies observable in the plots that had power levels that exceeded K times the average power level of all frequencies. Effective filtering was accomplished with K=128. Then all 16 Fourier coefficients associated with each detected frequency and 32 additional coefficients, i.e., 16 on each side, were set to zero. The resulting sets of coefficients were then subjected to the inverse Fourier transform, which reconstitutes the data set. Figures G-7 and G-8 show the histograms of the frequency filtered data.

Because of the difficulties with the Georgetown, DE, data that are obvious in Figs. F-13 and F-15, this same frequency filtering process was applied to the first-stage edited data of all three segments of the Georgetown data. Figures G-9 through G-32 show the results.

The "before" and "after" filtering times of arrival of the standard third-cycle zero crossing and the voltage at the 12th sample point were computed also. Their values, along with their standard deviations based on 8192 individual pulses, are presented in Tables 3 and 4.

A comparison of the mean values of the second-stage edited data after filtering in Tables 3 and 4 with the corresponding mean values computed for the unfiltered data indicates that both processes obtained the same result. We conclude, therefore, that the Georgetown problem is not the result of the coherent interference shown by the histograms. It now appears more likely that any measure of pulse arrival time is so sensitive a function of observed shape that even more sophisticated methods must be used to quantify it. Unfortunately, program plans did not permit further development of the analysis.

Table 3

Effect of Frequency Filter on
Time of Arrival of Standard Third-
Cycle Zero Crossing in Microseconds

Site	Segment	Before Filtering				After Filtering			
		First-Stage Edit		Second-Stage Edit		First-Stage Edit		Second-Stage Edit	
		Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Danville, IN	1	0.0006	0.0372	0.0004	0.0358	0.0006	0.0343	0.0003	0.0330
NAVOBSY	1	0.1375	0.6639	0.1332	0.6475	0.0095	0.3842	-0.0100	0.3216
Georgetown, DE	1	0.2808	0.9624	0.2715	0.7813	0.2270	0.8812	0.2147	0.6634
NAVOBSY	1	0.2015	0.9777	0.2051	0.8192	0.0850	0.8007	0.0823	0.5774
Georgetown, DE	2	0.2621	0.9889	0.2675	0.8008	0.2003	0.9089	0.2010	0.6896
NAVOBSY	2	0.1870	1.0039	0.1943	0.8393	0.0635	0.8505	0.0702	0.6068
Georgetown, DE	3	0.2554	0.9482	0.2659	0.7728	0.1955	0.8543	0.2051	0.6553
NAVOBSY	3	0.2083	0.9709	0.2022	0.8155	0.0838	0.7914	0.0815	0.5691

Table 4

Effect of Frequency Filter on Amplitude of the 12th Sample Point in Volts

		Before Filtering				After Filtering			
		First-Stage Edit		Second-Stage Edit		First-Stage Edit		Second-Stage Edit	
Site	Data Segment	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Danville, IN	1	0.29079	0.00727	0.29078	0.00713	0.29071	0.00696	0.29070	0.00682
NAVOBSY	1	0.13209	0.04558	0.13137	0.04221	0.12204	0.02887	0.12213	0.02462
Georgetown, DE	1	0.11268	0.07499	0.10545	0.04206	0.09178	0.06516	0.09136	0.04059
NAVOBSY	1	0.14652	0.08069	0.13995	0.05444	0.12239	0.07112	0.12214	0.04615
Georgetown, DE	2	0.11423	0.07377	0.10716	0.04373	0.09151	0.06785	0.09209	0.04183
NAVOBSY	2	0.14861	0.08541	0.14087	0.05527	0.12110	0.07928	0.12232	0.04798
Georgetown, DE	3	0.11238	0.07054	0.10666	0.04103	0.09256	0.06169	0.09293	0.03842
NAVOBSY	3	0.14755	0.08004	0.14132	0.05462	0.12317	0.06951	0.12376	0.04490

4. CONCLUDING REMARKS

We hope that we have shed some light on the intricacies of Loran-C pulse propagation. However, much still remains to be understood. If there are others who wish to contribute their expertise, the recorded data can be made available to them. For copies of the data tapes, contact the Loran System Program Office of the U.S. Air Force Electronic Systems Division at Hanscom AFB, MA 01731.

5. REFERENCE

1. Anon., "Loran-C System Characterization," Wild Goose Association Report, WGA Publication No. 1/1976, September 1976.

Appendix A

DATA PROCESSING COMPUTER PROGRAMS

The fundamental data processing was accomplished in two stages, as shown in Fig. A-1. The first stage, referred to as the preprocessor, accepts the raw data tape as input, along with certain control parameters punched on IBM computer cards. The data on this tape were formatted by a Kennedy Model 9232 buffered formatter. The data from the fixed site were treated as the master system and were normally processed first, followed by field site data, which were time correlated, by program control, with the master system. Data fill of zeroes was output, when necessary, to flag missing simultaneous data at the beginning or end of the field site recording. Other than time correlation, both sets of data were processed in the same way.

The output of the preprocessor includes (a) a 9-track magnetic tape (condensed data) collated with all data from each mission, (b) a punched card deck of control parameters, and (c) a tabulation with means and standard deviations of the first 16 measurements of all 50 pulse blocks and the total 20-min data run.

A first-stage edit function is performed by removing all data that may have reached the limiting values of the A to D converter. These data are flagged and not included in any subsequent calculations. When it is found necessary to edit any measurement, the entire set of 32 readings of that pulse is eliminated.

Finally, a plot of the absolute mean values is presented showing the approximate shape of the loran pulse envelope and behavior of the zero crossing points.

The programs used for preprocessing the data are documented in Program Listings A-1 through A-28 and Flow Charts A-1 through A-28.

The second stage of processing starts with the second-stage editor. It accepts, as input, the output tape of the preprocessor and the punched card deck that contains the editing criteria. It then performs a 2 sigma editing on each data point in the 50 pulse blocks. Again, the entire pulse is removed from the computation of new means and standard deviations if any one measurement exceeds the threshold. Intermediate means of each page are printed at the bottom of each page, and at the end of each data set the final mean and standard deviation about the block mean are printed.

The final page of printout contains certain group/phase measurement (GPM) computations. The first four values in the row labeled T10 through T16 describe the distance from the zero crossing to the measurement point for the 9th, 11th, 13th, and 15th sample of the pulse. The last three values, labeled GPM12 through GPM16, are intercept points of a straight line fit of successive five point sets of amplitude means surrounding the third cycle. All of the GPM calculations use the "page" means, A_i, made up of 14 block averages.

$$T(N) = -\ 3.18 \times A_{N-1}/(A_N - A_{N-2})$$

$$GPM(N) = 10 \sum_i |A_i|/(2(|A_N| - |A_{N-8}|) + |A_{N-2}| - |A_{N-6}|)$$

$$i = N-8, N-6, N-4, N-2, N$$

The programs used for second-stage editing are documented in Program Listings A-29 through A-33 and Flow Charts A-29 through A-33.

A secondary data processing system, the group/phase frequency filter (Fig. A-2), accepts, as input, the original raw data tape and control parameters from punched cards. Although several options are available in the program, only histograms and frequency filtering of one pair of measurements were of interest. A specified amount of data is reduced, and the 11th sample, which is near a zero crossing, and the 12th sample of the pulse, which is near a peak, are presented both as a two-dimensional histogram (in pairs) and respective marginal histograms. Means and standard deviations are also computed. Both sets of data are then independently subjected to a Fast Fourier Transform. Any unwanted energy spectra are then notch filtered (coefficients set zero) and then returned to the time domain by use of the inverse transform. The reconstructed, filtered data are then redisplayed in the initial histogram format, along with new means and standard deviations.

The programs used for frequency filtering are documented in Program Listings A-34 through A-58 and Flow Charts A-34 through A-58.

The three sets of programs described above call subroutines from a library. These subroutines are documented in Program Listings A-59 through A-67 and Flow Charts A-59 through A-67.

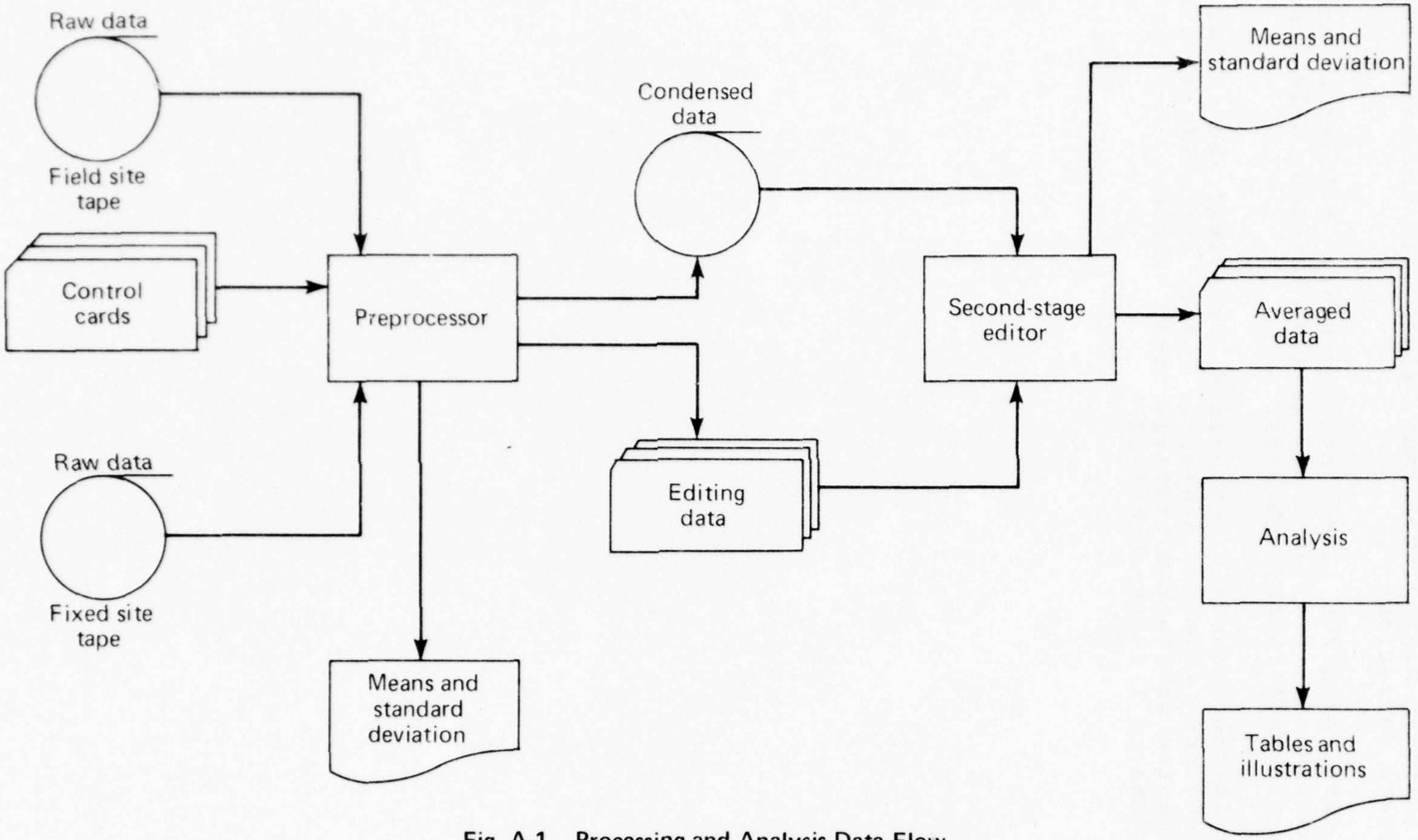


Fig. A-1 Processing and Analysis Data Flow

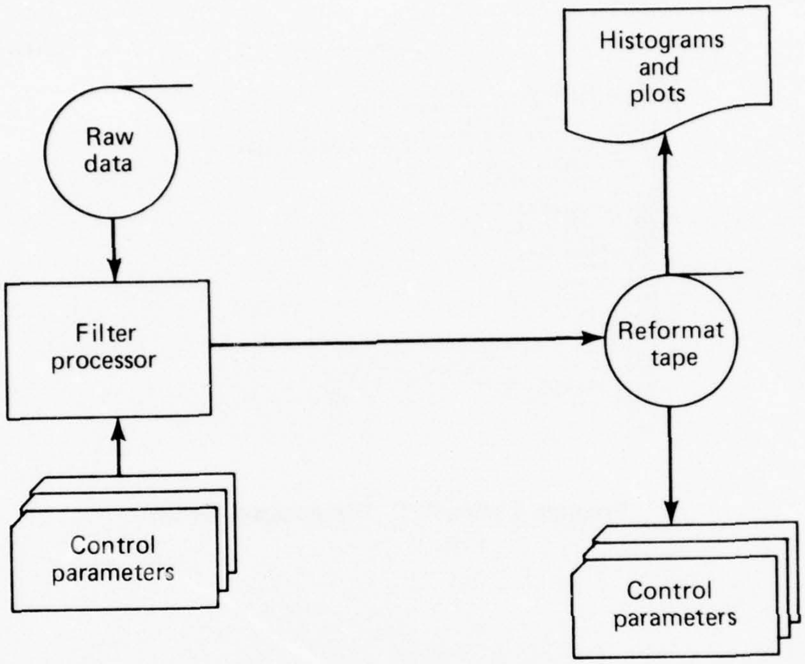


Fig. A-2 Frequency Filter Data Flow

```
09/28/76          INPUT LISTING                      AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE        (LIST,NAMS2)
                                                                                               ****
  CARD NO          ****                          CONTENTS

                     IMPLICIT REAL*8 (A-H,O-Z)
                     DIMENSION JCHK(5),IHD(40),IBUF(128)
                     DIMENSION GRDICT(3,16)
                     DIMENSION ITMP(2,10),IREF(2,25)
                     COMMON IHD,GRDICT,IREFR,IREFF,IREF,IRC,IREF,ITMP
                     COMMON/GETDAT/IRT,IBUF
                     COMMON/BIAS/IBIAS
                     IRC=0
                   1 CALL CRDIN(JCHK)
                     IF(JCHK(1))3,4,2
                   2 CALL SKIP
                     CALL HDCHK(JCHK)
                     CALL PRNTTL
                     CALL DATE(JCHK)
                     CALL PRNTHD
                     CALL MAINF
                     CALL STAT1
                     CALL GPM
                   3 CALL PLOT
                     GO TO 1
                   4 IF(IHD(5).NE.0) GO TO 5
                     REWIND 21
                   5 STOP
                     END
```

Program Listing A-1 Preprocessor Driver

```
09/28/76          INPUT LISTING                      AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE        (LIST,NAMS3)
                                                                                               ****
  CARD NO          ****                          CONTENTS

                     SUBROUTINE SKIP
              C      SUB TO SKIP FIRST SHORT RECORD IN THE FILE
                     DIMENSION IBUF(128)
                     COMMON/GETDAT/IRT,IBUF
                   1 CALL GETREC
                     RETURN
                     END
```

Program Listing A-2 Preprocessor Short Record Skip

```
09/23/76        INPUT LISTING                       AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSO)

  CARD NO        ****                          CONTENTS                              ****

            SUBROUTINE CRDIN(JCHK)
            DIMENSION JCHK(1),IBUF(128),IHD(40)
            DIMENSION ITMR(3,25)
            DOUBLE PRECISION TREF(2,25)
            DOUBLE PRECISION GRDTOT(3,16)
            DOUBLE PRECISION TREFB,TREFF
            COMMON IHD,GRDTOT,TREFB,TREFF,IREF,IRC,TREF,ITMR
            COMMON/GETDAT/IPT,IBUF
            COMMON/BIAS/IBIAS
      C     IHD(20) IS USED TO PICKUP 2ND SET OF 16 SAMPLES IN SUB BLOCK
      C     IHD(21) IS USED FOR INTERMEDIATE PRINTOUT IN SUB BLOCK
            IRD=5
            IREF=0
            READ(IRD,1000)(JCHK(K),K=1,5),(IHD(I),I=12,14),IBIAS,IHD(20),
           1IHD(21)
            IF(IHD(12))2,1,3
          2 TREFB=TREF(1,IHD(13))
            TREFF=TREF(2,IHD(13))
            IHD(12)=ITMR(1,IHD(13))
            IHD(14)=ITMR(3,IHD(13))
            IHD(13)=ITMR(2,IHD(13))
            IREF=1
            GO TO 1
          3 READ(IRD,1002)TREFB,TREFF
            IREF=1
          1 RETURN
       1000 FORMAT(11I6)
       1002 FORMAT(2F15.7)
            END
```

Program Listing A-3 Preprocessor Initialization

```
09/23/76        INPUT LISTING                       AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSO)

  CARD NO        ****                          CONTENTS                              ****

            SUBROUTINE HDCHK(JCHK)
            DIMENSION ICHK(5),JCHK(1),IHD(40),IBUF(128)
            COMMON IHD
            COMMON/GETDAT/IPT,IBUF
            DATA ICHK/' DAY','YEAR','XMTR','SITE','MODE'/
            IPT=6
            WRITE(IPT,1003)
      C     READ HEADER AND DECODE
            CALL RDHD
            DO 1 I=1,5
            IF(IHD(I).EQ.JCHK(I)) GO TO 1
            WRITE(IPT,1000)ICHK(I).IHD(I)
            WRITE(IPT,1001)
            JCHK(I)=IHD(I)
          1 CONTINUE
            RETURN
       1000 FORMAT(20X,A4,' DOES NOT MATCH:,'I3,' IS ON TAPE')
       1001 FORMAT(20X,'WILL USE CODE ON TAPE')
       1003 FORMAT('1')
            END
```

Program Listing A-4 Preprocessor Header Information Check

```
09/28/76        INPUT LISTING                       AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSO)

 CARD NO          ****                              CONTENTS                              ****

                        SUBROUTINE RDHD
                        DIMENSION IBUF(128),IHD(40)
                        DOUBLE PRECISION GPOTOT(2,16),TREFR,TREFF
                        COMMON IHD,GPOTOT,TREFR,TREFF,IREF
                        COMMON/GETDAT/IPT,IBUF
                  C     1=JULIAN DAY
                  C     2=YEAR-1970
                  C     3=XMIR NO.
                  C     4=SITE NO.
                  C     5=DATA MODE
                  C     6=ATMOS PRESS
                  C     7=OUTSIDE WET BULB
                  C     8=OUTSIDE DRY BULB
                  C     9=ATTENUATION
                  C     10=INSIDE DRY BULB
                  C     11=TIME CALIBRATION
                  C     12=HOURS START TIME
                  C     13=MINUTES START TIME
                  C     14=SECONDS START TIME
                  C     15=WEATHER CODE
                  C     16=NOTE CODE
                  C     17=GRI
                  C     18=START TIME IN SECONDS AFTER MIDNIGHT
                  C     20=16 SAMPLE SELECTION
                  C     21=INTERMEDIATE PRINTOUT FLAG
                  C     22=DAY NUMBER
                  C     23=MONTH NUMBER
                  C     39=MISSING RECORD COUNT
                  C     40=BAD PULSE PER BLOCK COUNT
                        IPT=6
                      3 CALL GETREC
                        GO TO(4,3,10,11),IPT
                  C     TIME TO EVEN SECOND
                      4 J=IBUF(113)
                        IF(IREF.NE.0) GO TO 6
                        DO 1 K=1,3
                        L=K+11
                        CALL SHFT1(I,J,8)
                        CALL BCDTB(IHD(L),I,2)
                      1 CONTINUE
                      6 CALL DATCOR
                  C     ATTENUATION
                        J=IBUF(114)
                        CALL SHFT1(I,J,24)
                        CALL SHFT1(I,J,8)
                        CALL BCDTB(IHD(9),I,2)
                  C     CALIBRATION TIME
                        J=IBUF(115)
                        M=1
                        CALL SHFT1(I,J,4)
                        IF(I.GT.0) M=-1
                        IHD(11)=0
                        DO 2 K=1,7
                        CALL SHFT1(I,J,4)
                      2 IHD(11)=IHD(11)*10+I
                        J=IBUF(116)
                        CALL SHFT1(I,J,8)
                        CALL BCDTB(K,I,2)
                        IHD(11)=(IHD(11)*100+K)*M
                  C     JULIAN DAY AND YEAR
                        CALL SHFT1(I,J,12)
                        CALL BCDTB(IHD(1),I,3)
                        CALL SHFT1(IHD(2),J,4)
                  C     XMIR CODE
                        CALL SHFT1(IHD(3),J,4)
                  C     MODE
                        CALL SHFT1(IHD(5),J,4)
                      5 J=IBUF(117)
                  C     SITE CODE
                        CALL SHFT1(I,J,8)
                        CALL BCDTB(IHD(4),I,2)
                  C     WEATHER CODE
                        CALL SHFT1(I,J,8)
                        CALL BCDTB(IHD(15),I,2)
                  C     NOTE CODE
                        CALL SHFT1(IHD(16),J,4)
                  C     INSIDE TEMP
                        CALL SHFT1(I,J,12)
                        CALL BCDTB(IHD(10),I,3)
                  C     OUTSIDE TEMP(WET,DRY)
                        J=IBUF(118)
                        CALL SHFT1(I,J,12)
                        CALL BCDTB(IHD(7),I,3)
                        CALL SHFT1(I,J,12)
                        CALL BCDTB(IHD(8),I,3)
                  C     PRESSURE
                        CALL SHFT1(I,J,8)
                        CALL BCDTB(IHD(6),I,2)
                        J=IBUF(119)
                        CALL SHFT1(I,J,12)
                        CALL BCDTB(K,I,3)
                        IHD(6)=IHD(6)*1000+K
                  C     GRI
                        CALL SHFT1(I,J,16)
                        J=IBUF(120)
                        CALL SHFT(I,J,4)
                        CALL BCDTB(IHD(17),I,4)
                  C
                  C     TEMP PATCH TO START ON GOOD RECORD
                  C     IF(IHD(2)+IHD(17).NE.998) GO TO 3
                  C
                  C
                        IHD(18)=IHD(12)*3600+IHD(13)*60+IHD(14)
                        RETURN
                     10 WRITE(IPT,1000)
                        GO TO 3
                     11 WRITE(IPT,1001)
                        STOP
```

Program Listing A-5   Preprocessor Header Information Decommutator

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

  CARD NO          ****                                 CONTENTS                                        ****

     109             1000 FORMAT(' EOF ENCOUNTERED, TRY AGAIN',///)
     110             1001 FORMAT(' NO DD CARD THIS FILE')
     111                  END
```

Program Listing A-5 Preprocessor Header Information Decommutator (concluded)

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSO)

  CARD NO          ****                                 CONTENTS                                        ****

       1                  SUBROUTINE DATCOR
       2            C     ADDED SUB TO CORRECT FOR WIRING ERROR IN CONTROL PANEL
       3            C     AN EXTRA FOUR BITS WERE INSERTED AFTER TIME OF DAY
       4                  DIMENSION IBUF(128),IHD(40)
       5                  COMMON IHD
       6                  COMMON/GETDAT/IRT,IBUF
       7                  I=IBUF(114)
       8                  J=IBUF(115)
       9                  CALL SHFT(I,J,-4)
      10                  CALL SHFT(I,K,-4)
      11                  CALL SHFT(I,J,8)
      12                  IBUF(114)=I
      13                  I=IBUF(115)
      14                  DO 1 L=115,120
      15                  J=IBUF(L)
      16                  CALL SHFT(I,J,4)
      17                  IBUF(L-1)=I
      18                  CALL SHFT(I,J,28)
      19                1 CONTINUE
      20                  RETURN
      21                  END
```

Program Listing A-6 Preprocessor Data Format Converter

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSC)

  CARD NO          ****                                 CONTENTS                                        ****

       1                  SUBROUTINE BCDTB(I,J,K)
       2                  M=0
       3                  I=0
       4                  L=-K*4
       5                  CALL SHFT(J,M,L)
       6                  DO 1 N=1,K
       7                  I=I*10
       8                  CALL SHFT1(J,M,4)
       9                1 I=I+J
      10                  RETURN
      11                  END
```

Program Listing A-7 Preprocessor BCD to Binary Converter

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSQ)

  CARD NO        ****                         CONTENTS                              ****

      SUBROUTINE PRNTTL
      IPT=6
      WRITE(IPT,2000)
    1 WRITE(IPT,2002)
      WRITE(IPT,1000)
      WRITE(IPT,1001)
      WRITE(IPT,1002)
      WRITE(IPT,1003)
      WRITE(IPT,1004)
      WRITE(IPT,1005)
      WRITE(IPT,2001)
      WRITE(IPT,1006)
      WRITE(IPT,1007)
      WRITE(IPT,1008)
      WRITE(IPT,1009)
      WRITE(IPT,1010)
      WRITE(IPT,1011)
      WRITE(IPT,2001)
      WRITE(IPT,1012)
      WRITE(IPT,1013)
      WRITE(IPT,1014)
      WRITE(IPT,1015)
      WRITE(IPT,1016)
      WRITE(IPT,1017)
      WRITE(IPT,2001)
      RETURN
 1000 FORMAT(32X,'JJ',4X,'HH',4X,'HH',4X,'UU',4X,'UU',9X,'//',5X,
     1'AAAAAA',5X,'PPPPPPP',5X,'LL')
 1001 FORMAT(32X,'JJ',4X,'HH',4X,'HH',4X,'UU',4X,'UU',8X,'//',5X,
     1'AA',4X,'AA',4X,'PP',4X,'PP',4X,'LL')
 1002 FORMAT(32X,'JJ',4X,'HHHHHHHH',4X,'UU',4X,'UU',7X,'//',6X,
     1'AAAAAAAA',4X,'PPPPPPP',5X,'LL')
 1003 FORMAT(32X,'JJ',4X,'HH',4X,'HH',4X,'UU',4X,'UU',6X,'//',7X,
     1'AA',4X,'AA',4X,'PP',10X,'LL')
 1004 FORMAT(26X,'JJ',4X,'JJ',4X,'HH',4X,'HH',4X,'UU',4X,'UU',5X,'//',
     18X,'AA',4X,'AA',4X,'PP',10X,'LL')
 1005 FORMAT(27X,'JJJJJJ',5X,'HH',4X,'HH',5X,'UUUUUU',5X,'//',9X,
     1'AA',4X,'AA',4X,'PP',10X,'LLLLLLLL')
 1006 FORMAT(3X,'GGGGGG',5X,'RRRRRRR',6X,'OOOOOO',5X,'UU',4X,'UU',4X,
     1'PPPPPPP',10X,'//',4X,'PPPPPPP',5X,'HH',4X,'HH',5X,'AAAAAA',6X,
     2'SSSSSS',5X,'EEEEEEEE')
 1007 FORMAT('  GG',5X,'G',4X,'RR',4X,'RR',4X,'OO',4X,'OO',4X,'UU',4X,
     1'UU',4X,'PP',4X,'PP',8X,'//',5X,'PP',4X,'PP',4X,'HH',4X,'HH',4X,
     2'AA',4X,'AA',4X,'SS',5X,'S',4X,'EE')
 1008 FORMAT('  GG',10X,'RRRRRRR',5X,'OO',4X,'OO',4X,'UU',4X,'UU',4X,
     1'PPPPPPP',8X,'//',6X,'PPPPPPP',5X,'HHHHHHHH',4X,'AAAAAAAA',5X,
     2'SSSSSS',5X,'EEEEEE')
 1009 FORMAT('  GG',3X,'GGG',4X,'RR',2X,'RR',6X,'OO',4X,'OO',4X,'UU',
     14X,'UU',4X,'PP',12X,'//',7X,'PP',10X,'HH',4X,'HH',4X,'AA',4X,
     2'AA',10X,'SS',4X,'EE')
 1010 FORMAT('  GG',4X,'GG',4X,'RR',3X,'RR',5X,'OO',4X,'OO',4X,'UU',4X,
     1'UU',4X,'PP',11X,'//',9X,'PP',10X,'HH',4X,'HH',4X,'AA',4X,'AA',
     24X,'SS',4X,'SS',4X,'EE')
 1011 FORMAT('   GGGGGG',5X,'RR',4X,'RR',5X,'OOOOOO',6X,'UUUUUU',5X,
     1'PP',10X,'//',9X,'PP',10X,'HH',4X,'HH',4X,'AA',4X,'AA',5X,
     2'SSSSSS',5X,'EEEEEEEE')
 1012 FORMAT(44X,'TTTTTTTT',4X,'EEEEEEEE',5X,'SSSSSS',5X,'TTTTTTTT')
 1013 FORMAT(47X,'TT',7X,'EE',10X,'SS',5X,'S',7X,'TT')
 1014 FORMAT(47X,'TT',7X,'EEEEEE',7X,'SSSSSS',8X,'TT')
 1015 FORMAT(47X,'TT',7X,'EE',16X,'SS',7X,'TT')
 1016 FORMAT(47X,'TT',7X,'EE',10X,'SS',4X,'SS',7X,'TT')
 1017 FORMAT(47X,'TT',7X,'EEEEEEEE',5X,'SSSSSS',9X,'TT')
 2000 FORMAT(1H1,//)
 2001 FORMAT(//)
 2002 FORMAT(////)
      END
```

Program Listing A-8   Preprocessor Title Page Printer

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO        ****                          CONTENTS                                  ****

                    SUBROUTINE DATE(JCHK)
                    DIMENSION IBUF(128),IHD(40)
                    DIMENSION A(6,8),MO(12),JCHK(1)
                    DOUBLE PRECISION A
                    COMMON IHD
                    COMMON/GETDAT/IRT,IBUF
                    DATA MO/31,59,90,120,151,181,212,243,273,304,334,365/
                    IPT=6
                    I=JCHK(1)
                    IY=JCHK(2)
                    DO 1 J=1,12
                    IF(I.GT.MO(J)) GO TO 1
                    IM=J
                    IHD(23)=IM
                    ID=I
                    IF(J.EQ.1) GO TO 4
                    ID=I-MO(J-1)
                  4 IHD(22)=ID
                    GO TO 2
                  1 CONTINUE
                    RETURN
                  2 CALL DDTDB(A,IM,ID,IY)
                    DO 3 K=1,6
                  3 WRITE(IPT,1000)(A(K,J),J=1,8)
                    RETURN
               1000 FORMAT(15X,8(4X,A8))
                    END
```

Program Listing A-9   Preprocessor Date Converter

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO        ****                          CONTENTS                                  ****

                    SUBROUTINE DDTDB(A,IM,ID,IY)
                    DOUBLE PRECISION A,B,C,D
                    DIMENSION A(6,8),B(6,11),C(54),D(12)
                    EQUIVALENCE (B(1,1),C(1)),(B(1,10),D(1))
                    DATA C/' 000000 ','00    00','00    00','00    00','00    00',
                   1' 000000 ','   111  ',' 1 11   ','   11   ','   11   ','   11   ',
                   2' 1111111',' 22222  ','22    22','    22  ','  22    ','22      ',
                   3'22222222',' 333333 ','33    33','    3333','      33','33    33',
                   4' 333333 ','    444 ',' 44 44  ','44   44 ','44444444','      44',
                   5'      44','55555555','55      ','5555555 ','      55','55    55',
                   6' 555555 ',' 666666 ','66     6','6666666 ','66    66','66    66',
                   7' 666666 ','77777777','     77 ','    77  ','   77   ','  77    ',
                   8' 77     ',' 888888 ','88    88',' 888888 ','88    88','88    88',
                   9' 888888 '/
                    DATA D/' 999999 ','99    99',' 9999999','      99','99    99',
                   1' 999999 ','      //','     // ','    //  ','   //   ','  //    ',
                   2' //     '/
                    K=IM/10+1
                    DO 1 I=1,6
                  1 A(I,1)=B(I,K)
                    K=IM-10*(K-1)+1
                    DO 2 I=1,6
                  2 A(I,2)=B(I,K)
                    DO 3 I=1,6
                    A(I,6)=B(I,11)
                  3 A(I,3)=B(I,11)
                    K=ID/10+1
                    DO 4 I=1,6
                  4 A(I,4)=B(I,K)
                    K=ID-10*(K-1)+1
                    DO 5 I=1,6
                  5 A(I,5)=B(I,K)
                    DO 6 I=1,6
                  6 A(I,7)=B(I,8)
                    K=IY+1
                    DO 7 I=1,6
                  7 A(I,8)=B(I,K)
                    RETURN
                    END
```

Program Listing A-10   Preprocessor Title Page Date Formatter

```
09/28/76        INPUT LISTING                    AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSQ)

 CARD NO        ****                        CONTENTS                              ****

          SUBROUTINE PRNTHD
          DIMENSION ASITE(3,12),AXMTR(2,9),AMODE(3,8),IHD(40),IBUF(128)
          DIMENSION WIND(2)
          DIMENSION WEATH1(2,5),WEATH2(2,10)
          DIMENSION ANOTE(2,2)
          DOUBLE PRECISION ASITE,AXMTR,AMODE,WEATH1,WEATH2,ANOTE
          COMMON IHD
          COMMON/GETDAT/IRT,IBUF
          DATA WIND/' LOW','HIGH'/
          DATA WEATH1/'CLEAR   ','        ','SCATTERE','D TO 50%',
         1'BROKEN T','O 90%   ','OVERCAST',' TO 100%','OBSCURAT','ION 100%'/
          DATA WEATH2/'THUNDERS','TORMS   ','RAIN SHO','WERS    ',
         1'DRIZZLE ','        ','FREEZING',' DRIZZLE','SNOW    ','        ',
         2'HAIL    ','        ','GROUND F','OG      ','FOG COVE','R       ',
         3'SUNNY   ','        ','HAZE    ','        '/
          DATA ANOTE/'SEE LOG*','********','NO PROBL','EMS*****'/
          DATA ASITE/'NAVAL OB','SERVATOR','Y, D.C. ','CAROLINA',' BEACH O',
         1'NE      ','CAROLINA',' BEACH T','WO      ','CAROLINA',' BEACH T',
         2'HREE    ','CAROLINA',' BEACH F','OUR     ','DANA ONE','        ',
         3'        ','DANA TWO','        ','        ','DANA THR','EE      ',
         4'        ','NANTUCKE','T ONE   ','        ','NANTUCKE','T TWO   ',
         5'        ','NANTUCKE','T THREE ','        ','APL/JHU ','        ',
         6'        '/
          DATA AXMTR/'CAROLINA',' BEACH  ','JUPITER ','INLET   ','CAPE RAC',
         1'E       ','NANTUCKE','T       ','DANA    ','        ','CAPE MAY',
         2'        ','LORAN SI','MULATOR ','100 KH C','ESIUM   ','SPECIAL ',
         3'TEST    '/
          DATA AMODE/'PRIMARY ','DATA    ','        ','SKYWAVE ','STUDY   ',
         1'        ','CALIBRAT','ION RUN ','        ','LAB EQUI','PMENT TE',
         2'ST      ','VAN EQUI','PMENT TE','ST      ','ANCILLAR','Y DATA  ',
         3'        ','SKYWAVE ','DIURNAL ','        ','SKYWAVE ','DETACHED',
         4'        '/
          IPT=6
          IWT=21
          WRITE(IPT,1011)
          IY=70+IHD(2)
          WRITE(IPT,1000)IHD(23),IHD(22),IY
          IY=1970+IHD(2)
          WRITE(IPT,1001)IHD(1),IY
          J=IHD(4)+1
          WRITE(IPT,1002)(ASITE(I,J),I=1,3)
          J=IHD(3)+1
          WRITE(IPT,1003)(AXMTR(I,J),I=1,2)
          J=IHD(5)+1
          WRITE(IPT,1004)(AMODE(I,J),I=1,3)
          WRITE(IPT,1012)IHD(9)
          HD=IHD(6)*.03386
          WRITE(IPT,1005)HD
          WRITE(IPT,1006)
          HD=IHD(7)/10.
          WRITE(IPT,1007)HD
          HD=IHD(8)/10.
          WRITE(IPT,1008)HD
          WRITE(IPT,1009)
          HD=IHD(10)/10.
          WRITE(IPT,1008)HD
          WRITE(IPT,1010)IHD(11)
          WRITE(IPT,1013)IHD(12),IHD(13),IHD(14)
          M=1
          K=IHD(15)/10
          IF(K.GT.4) M=2
          K=MOD(K,5)+1
          L=MOD(IHD(15),10)+1
          WRITE(IPT,1018)
          WRITE(IPT,1014)(WEATH1(N,K),N=1,2)
          WRITE(IPT,1017)(WEATH2(N,L),N=1,2)
          WRITE(IPT,1015)WIND(M)
          WRITE(IPT,1019)IHD(17)
          WRITE(IPT,1016)(ANOTE(N,IHD(16)+1),N=1,2)
    C
    C
          IF(IHD(5).NE.0) GO TO 1
          WRITE(21)IHD
    C
    C
        1 RETURN
     1000 FORMAT(35X,'GROUP/PHASE TEST PREPROCESSING',2X,I2,2('/',I2))
     1001 FORMAT('0',34X,'JULIAN DAY NO.',I4,9X,'YEAR NO.',I5)
     1002 FORMAT('0',34X,'DATA RECORDED AT:',3X,3A8)
     1003 FORMAT('0',34X,'TRANSMITTER LOCATED AT:',3X,2A8)
     1004 FORMAT('0',34X,'DATA RECORDING MODE:',3X,3A8)
     1005 FORMAT('0',34X,'ATMOSPHERIC PRESSURE:,'F7.1,' MILLIBARS')
     1006 FORMAT('0',34X,'EXTERNAL TEMPERATURE (DEGREES CENTIGRADE)')
     1007 FORMAT(45X,'WET BULB',F5.1)
     1008 FORMAT(45X,'DRY BULB',F5.1)
     1009 FORMAT('0',34X,'INTERNAL TEMPERATURE (DEGREES CENTIGRADE)')
     1010 FORMAT('0',34X,'PRED. TIME CALIB:',I11,'.0E-09 SECONDS')
     1011 FORMAT('1',/////)
     1012 FORMAT('0',34X,'ATTENUATION IN DB:,'I3)
     1013 FORMAT('0',34X,'START TIME:',I4,':',I2,':',I2)
     1014 FORMAT(45X,'CLOUD COVER: ',2A8)
     1015 FORMAT(45X,A4,' GROUND WINDS')
     1016 FORMAT(////,35X,'************',2A8,'************')
     1017 FORMAT(45X,'GENERAL CONDITION: ',2A8)
     1018 FORMAT('0',34X,'WEATHER:')
     1019 FORMAT('0',34X,'GROUP REPETITION INTERVAL:',I4,'.0E-04')
          END
```

Program Listing A-11   Preprocessor Header Page Printer

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO        ****                        CONTENTS                              ****

      SUBROUTINE MAINE
      DIMENSION IBUF(128),DAT(800),IHD(40)
      DIMENSION ITMR(3,25)
      DIMENSION GRDTOT(3,16)
      DOUBLE PRECISION TREF(2,25)
      DOUBLE PRECISION TB,TBP,TD,GRI
      DOUBLE PRECISION GRDTOT
      DOUBLE PRECISION TREFB,TREFF
      COMMON IHD,GRDTOT,TREFB,TREFF,IREF,IRC,TREF,ITMR
      COMMON/GETDAT/IRT,IBUF
      IPT=6
      IJF=0
      CALL CLEAR(GRDTOT,48)
      GRI=IHD(17)*.0001D0
C     IHD(37) IS TOTAL NO. OF REJECTED PULSES
      IHD(37)=0
C     IHD(38) IS TOTAL NO OF MISSING RECORDS
      IHD(38)=0
      NPRNT=14
      IPCT=0
      IERR=0
      CALL TIME(TB)
      IRC=IRC+1
      TREF(1,IRC)=TB
      ITMR(1,IRC)=IHD(12)
      ITMR(2,IRC)=IHD(13)
      ITMR(3,IRC)=IHD(14)
      TBP=TB
      IF(IREF.EQ.0) GO TO 8
      CALL FINDT(TREFB,TBP,GRI,IPCT,IJF)
    8 IF(NPRNT.LT.14)GO TO 9
      WRITE(IPT,1003)
      WRITE(IPT,1004)
      NPRNT=0
    9 CALL SET(DAT)
      IDCT=0
C     IHD(39) IS USED TO COUNT MISSING RECORDS
      IHD(39)=0
C     IHD(40) IS USED TO COUNT BAD PULSES IN A BLOCK
      IHD(40)=0
      TD=TBP+IPCT*GRI
      IF(IJF.NE.0) GO TO 16
   10 CALL BLOCK(DAT,IDCT,IPCT,IERR)
      IF(IDCT.LT.800) GO TO 11
      CALL STAT(TD,DAT)
      TREF(2,IRC)=TD
      IHD(37)=IHD(37)+IHD(40)
      IHD(38)=IHD(38)+IHD(39)
      IF(IHD(21).EQ.0) GO TO 100
      IF((GRDTOT(3,1)+.5).GE.500) RETURN
  100 NPRNT=NPRNT+1
      IF(IREF.EQ.0) GO TO 101
      IF(DABS(TD-TREFF).LT..01) GO TO 21
      IF(TD.GT.TREFF) GO TO 21
  101 IF(IPCT.LT.7) GO TO 8
   11 TBP=TBP+7*GRI
      IPCT=0
      IF(IERR.NE.0) GO TO 14
   12 CALL GETREC
      GO TO(13,12,17,18),IRT
C     TEST FOR CHANGE OF RECORDING MODE
   13 CALL MODESB(MDSV)
      IF(IHD(5).NE.MDSV) GO TO 19
      CALL TIME(TB)
C     TEST FOR MISSING RECORD
   14 IF((TB-TBP).GT..6) GO TO 16
C     TEST FOR INTERMEDIATE RECORD
      IF((TBP-TB).GT..001) GO TO 12
      IERR=0
      TBP=TB
   15 IF(800-IDCT)8,8,10
   16 IERR=1
      IHD(39)=IHD(39)+1
      IJF=0
      GO TO 15
C  19 SHOULD ATTEMPT BACKSPACE ON INPUT IF POSSIBLE
   19 CONTINUE
   17 IF(IHD(5).NE.0) GO TO 20
      IF(IREF.EQ.0) GO TO 22
      TB=9999.
      GO TO 16
   21 IF(TB.EQ.9999.) GO TO 22
      CALL SKIPFL
   22 ENDFILE 21
   20 RETURN
   18 WRITE(IPT,1000)
      STOP
 1000 FORMAT(' NO DD CARD THIS FILE')
 1003 FORMAT(1H1,16(2X,'AVG.',2X))
 1004 FORMAT(1X,16(3X,'S.DEV'),/)
      END
```

Program Listing A-12   Preprocessor Main Data Handler

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSO)

  CARD NO         ****                           CONTENTS                                  ****

                        SUBROUTINE BLOCK(DAT,IDCT,IPCT,IERR)
                        DIMENSION DAT(1),IBUF(128),IHD(40)
                        COMMON IHD
                        COMMON/GETDAT/IPT,IBUF
                        IPT=6
                        IP=IPCT+1
                        DO 2 I=IP,7
                        DO 1 J=1,8
                        IDCT=IDCT+2
                        IF(IERR.NE.0) GO TO 1
                  C     IHD(20) USED FOR PICKING UP ANY SERIES OF 16 PULSES
                        K=16*(I-1)+J+IHD(20)
                        CALL XY(IDCT,K,DAT,J)
                      1 CONTINUE
                  C     IHD(21) IS USED FOR INTERMEDIATE PRINTOUT OF EACH READING
                        IF(IHD(21).EQ.0) GO TO 4
                        M=IDCT-15
                        WRITE(IPT,1000)(DAT(N),N=M,IDCT)
                      4 IF(IDCT.EQ.200) GO TO 3
                      2 CONTINUE
                      3 IPCT=I
                        RETURN
                   1000 FORMAT(16F8.4)
                        END
```

Program Listing A-13 Preprocessor Data Blocker

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSO)

  CARD NO         ****                           CONTENTS                                  ****

                        SUBROUTINE FINDT(TREFR,TBP,GRI,IPCT,IJF)
                        IMPLICIT REAL*8(A-H,O-Z)
                        DIMENSION IBUF(128)
                        COMMON/GETDAT/IPT,IBUF
                        TD=DABS(TBP-TREFR)
                        IF(TD.LT..01) RETURN
                        DO 1 I=1,100000
                        T=TD-GRI*I
                        IF(DABS(T).LT..01) GO TO 2
                      1 CONTINUE
                      2 IPCT=MOD(I,7)
                        N=I/7
                        IF(TBP-TREFR) 3,5,10
                      3 IF(N.EQ.0) RETURN
                        DO 4 I=1,N
                      4 CALL GETREC
                        CALL TIME(TBP)
                      5 RETURN
                     10 IF(IPCT.EQ.0) GO TO 11
                        N=N+1
                        IPCT=7-IPCT
                     11 TBP=TBP-N*7*GRI
                        IJF=1
                        RETURN
                        END
```

Program Listing A-14 Preprocessor Pulse Time Locater

```
09/28/76          INPUT LISTING                         AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO         ****                          CONTENTS                                  ****

      SUBROUTINE TIME(TB)
      DIMENSION IBUF(128),IHD(40)
      DOUBLE PRECISION TB
      COMMON IHD
      COMMON/GETDAT/IRT,IBUF
      COMMON/BIAS/IBIAS
      K=IBUF(113)
      TB=0.0D0
      DO 1 I=1,3
      J=I+11
      CALL SHFT1(L,K,8)
      CALL BCDTB(M,L,2)
    1 TB=(M-IHD(J))*60**(3-I)+TB
      CALL SHFT1(L,K,8)
      CALL BCDTB(M,L,2)
      TB=TB+M*.01D0
      K=IBUF(114)
      CALL SHFT1(L,K,20)
      CALL BCDTB(M,L,5)
      TB=TB+M*.0000001D0+IBIAS
      RETURN
      END
```

Program Listing A-15   Preprocessor Time Decoder

```
09/28/76          INPUT LISTING                         AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO         ****                          CONTENTS                                  ****

      SUBROUTINE SET(DAT)
      DIMENSION DAT(1)
      DO 1 I=1,800
    1 DAT(I)=9999.
      RETURN
      END
```

Program Listing A-16   Preprocessor Data Block Initializer

```
09/28/76          INPUT LISTING                         AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO         ****                          CONTENTS                                  ****

      SUBROUTINE XY(IDCT,K,DAT,L)
      DIMENSION DAT(1),IBUF(128),IHD(40)
      COMMON IHD
      COMMON/GETDAT/IRT,IBUF
      I=IBUF(K)
      CALL SHFT1(J,I,32)
      CALL SHFT2(J,I,-16)
      DAT(IDCT-1)=J*1.2208375E-3
      CALL SHFT1(J,I,32)
      CALL SHFT2(J,I,-16)
      DAT(IDCT)=J*1.2208375E-3
      CALL EDIT(IDCT,DAT,L)
      RETURN
      END
```

Program Listing A-17   Preprocessor Measurement Decoder

```
09/28/7-        INPUT LISTING                         AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO          ****                          CONTENTS                              ****

                      SUBROUTINE STAT(TD,DAT)
                      DIMENSION DAT(1),XY(16),XY2(16),XYSD(16),XYN(16)
                      DIMENSION GRDTOT(3,16)
                      DIMENSION IBUF(128),IHD(40)
                      DOUBLE PRECISION TD,XY,XY2,XYSD,XYN
                      DOUBLE PRECISION GRDTOT
                      DOUBLE PRECISION TEMP
                      COMMON IHD,GRDTOT
                      COMMON/GETDAT/IPT,IBUF
                      IPT=6
                      CALL CLEAR(XYN,16)
                      CALL CLEAR(XY,16)
                      CALL CLEAR(XY2,16)
                      CALL CLEAR(XYSD,16)
                      DO 1 I=1,800
                      IF(DAT(I).GT.9000.) GO TO 1
                      J=MOD(I,16)
                      IF(J.EQ.0) J=16
                      TEMP=DAT(I)
                      XY(J)=XY(J)+TEMP
                      XY2(J)=XY2(J)+TEMP**2
                      XYN(J)=XYN(J)+1
                    1 CONTINUE
                      DO 2 I=1,16
                      IF(XYN(I).EQ.0) GO TO 2
                      GRDTOT(1,I)=GRDTOT(1,I)+XY(I)
                      GRDTOT(2,I)=GRDTOT(2,I)+XY2(I)
                      GRDTOT(3,I)=GRDTOT(3,I)+XYN(I)
                      XY(I)=XY(I)/XYN(I)
                      XY2(I)=XY2(I)/XYN(I)
                      XYSD(I)=DSQRT(XY2(I)-XY(I)**2)
                    2 CONTINUE
                      WRITE(IPT,1003)TD,XYN(1),IHD(40),IHD(39)
                      WRITE(IPT,1000)XY
                      WRITE(IPT,1001)XYSD
                      IF(IHD(5).NE.0) GO TO 3
                      WRITE(21)TD,XY,XYSD,XYN,(DAT(I),I=1,800)
                    3 RETURN
                 1000 FORMAT(1X,16F8.4)
                 1001 FORMAT(2X,16F8.4,/)
                 1003 FORMAT(' BLOCK TIME = ',F12.7,
                     110X,'TOTAL PULSES KEPT =',F3.0,
                     210X,'NO. OF PULSES EDITED =',I2,
                     310X,'NO. OF MISSING RECORDS =',I2)
                      END
```

Program Listing A-18 Preprocessor Intermediate Statistics

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO          ****                          CONTENTS                                   ****

      1                   SUBROUTINE CLEAR(X,N)
      2                   DOUBLE PRECISION X(N)
      3                   DO 1 I=1,N
      4                 1 X(I)=0.0D0
      5                   RETURN
      6                   END
```

Program Listing A-19 Preprocessor Array Reset

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO          ****                          CONTENTS                                   ****

      1                   SUBROUTINE EDIT(IDCT,DAT,J)
      2                   DIMENSION IBUF(128),IHD(40)
      3                   DIMENSION DAT(1)
      4                   COMMON IHD
      5                   COMMON/GETDAT/IRT,IBUF
      6                   IF(ABS(DAT(IDCT-1)).GT.10.) GO TO 1
      7                   IF(ABS(DAT(IDCT)).GT.10.) GO TO 1
      8                   RETURN
      9                 1 IDCT=IDCT-2*J
     10                   IHD(40)=IHD(40)+1
     11                   DO 2 J=1,8
     12                   IDCT=IDCT+2
     13                   DAT(IDCT-1)=9999.
     14                   DAT(IDCT)=9999.
     15                 2 CONTINUE
     16                   RETURN
     17                   END
```

Program Listing A-20 Preprocessor First-Stage Editor

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSC)

                                                                                               ****
  CARD NO        ****                              CONTENTS

     1                  SUBROUTINE STAT1
     2                  DIMENSION IBUF(128),IHD(40)
     3                  DIMENSION GRDTOT(3,16)
     4                  DOUBLE PRECISION GRDTOT
     5                  COMMON IHD,GRDTOT
     6                  COMMON/GETDAT/IPT,IBUF
     7                  IPT=6
     8                  DO 1 I=1,16
     9                  IF(GRDTOT(3,I).EQ.0) GO TO 1
    10                  GRDTOT(1,I)=GRDTOT(1,I)/GRDTOT(3,I)
    11                  GRDTOT(2,I)=GRDTOT(2,I)/GRDTOT(3,I)
    12                  GRDTOT(2,I)=DSQRT(GRDTOT(2,I)-GRDTOT(1,I)**2)
    13                1 CONTINUE
    14                  I=GRDTOT(3,1)+.5
    15                  WRITE(IPT,1002)I
    16                  WRITE(IPT,1000)(GRDTOT(1,I),I=1,16)
    17                  WRITE(IPT,1001)(GRDTOT(2,I),I=1,16)
    18                  WRITE(IPT,1003)IHD(37)
    19                  WRITE(IPT,1004)IHD(38)
    20                  IF(IHD(5).NE.0) GO TO 3
    21                  ADD=0.
    22                  DO 2 J=1,16
    23                2 ADD=ADD+GRDTOT(2,J)
    24                  ADD=ADD/8
    25                  WRITE(7,1005)ADD
    26                  WRITE(7,1005)(GRDTOT(1,I),I=1,16)
    27                3 RETURN
    28             1000 FORMAT(1X,16F8.4)
    29             1001 FORMAT(2X,16F8.4,/)
    30             1002 FORMAT(' GRAND TOTALS OVER',I6,' PULSES ARE AS FOLLOWS')
    31             1003 FORMAT(//,10X,'TOTAL NUMBER OF REJECTED PULSES =',I5)
    32             1004 FORMAT(//,10X,'TOTAL NUMBER OF MISSING OR SHORT RECORDS =',I5)
    33             1005 FORMAT(8F9.4,/,8F9.4)
    34                  END
```

Program Listing A-21   Preprocessor Final Statistics

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSC)

                                                                                               ****
  CARD NO        ****                              CONTENTS

     1                  SUBROUTINE MODESR(MDSV)
     2                  DIMENSION IBUF(128),IHD(40)
     3                  COMMON IHD
     4                  COMMON/GETDAT/IPT,IBUF
     5                  CALL SHFT1(MDSV,IBUF(117),4)
     6                  RETURN
     7                  END
```

Program Listing A-22   Preprocessor Recording Mode Decoder

```
09/28/76        INPUT LISTING                    AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO         ****                          CONTENTS                          ****

     1                  SUBROUTINE PLOT
     2                  DIMENSION IHD(40),IBUF(128)
     3                  DIMENSION GRDTOT(3,16),MARK(14)
     4                  DOUBLE PRECISION GRDTOT
     5                  COMMON IHD,GRDTOT
     6                  COMMON/GETDAT/IPT,IBUF
     7                  IPT=6
     8                  WRITE(IPT,1000)
     9                  AMX=0
    10                  DO 1 I=2,16
    11                  IF(AMX.LT.DABS(GRDTOT(1,I))) AMX=DABS(GRDTOT(1,I))
    12                1 CONTINUE
    13                  MX=AMX+1
    14                  MD=55/MX
    15                  DO 10 I=1,55
    16                  L=55-I
    17                  IC=1078657024
    18                  IF(MOD(L,MD).EQ.0) IC=(L/MD)*65536+1089470464
    19                  DO 20 J=1,14
    20                  V=DABS(GRDTOT(1,J+2))
    21                  MARK(J)=1073741824
    22                  K=55-MD*V
    23                  IF(I.NE.K) GO TO 20
    24                  MARK(J)=-922746880+MOD(J,2)*251658240
    25               20 CONTINUE
    26               10 WRITE(IPT,1001) IC,MARK
    27                  WRITE(IPT,1002)
    28                  RETURN
    29             1000 FORMAT('1',13X,14('|',6X))
    30             1001 FORMAT(11X,A2,1X,14(A1,6X))
    31             1002 FORMAT(14X,14('|',6X))
    32                  END
```

Program Listing A-23   Preprocessor Plotter

```
09/28/76        INPUT LISTING                    AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO         ****                          CONTENTS                          ****

     1                  SUBROUTINE SKIPFL
     2                  DIMENSION IBUF(128)
     3                  COMMON/GETDAT/IPT,IBUF
     4                1 CALL GETREC
     5                  GO TO(1,1,3,2),IPT
     6                2 WRITE(6,1000)
     7                3 RETURN
     8             1000 FORMAT(1X,'NO DD CARD THIS FILE (SKIPFL)')
     9                  END
```

Program Listing A-24   Preprocessor File Skip

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO          ****                         CONTENTS                              ****

                         SUBROUTINE GPM
                         IMPLICIT REAL*8(A-H,O-Z)
                         DIMENSION IHD(40),GRDTOT(3,16),OUT(7)
                         COMMON IHD,GRDTOT
                         IPT=6
                         DO 1 I=1,4
                         J=2*(I+4)
                       1 OUT(I)=-GRDTOT(1,J-1)*3.18/(GRDTOT(1,J)-GRDTOT(1,J-2))
                         DO 2 I=1,3
                         J=I+4
                         OUT(J)=0.0D0
                         DO 3 K=1,5
                         L=2*(I+K)
                       3 OUT(J)=OUT(J)+DABS(GRDTOT(1,L))
                         K=2*(I+1)
                         TEMP=2*(DABS(GRDTOT(1,K+8))-DABS(GRDTOT(1,K)))
                         TEMP=TEMP+DABS(GRDTOT(1,K+6))-DABS(GRDTOT(1,K+2))
                       2 OUT(J)=OUT(J)*10/TEMP
                         WRITE(IPT,1000)(I,I=10,16,2),(J,J=12,16,2)
                         IF(IHD(3).NE.7) GO TO 4
                         WRITE(IPT,1001)(OUT(I),I=1,4)
                         GO TO 5
                       4 WRITE(IPT,1001)OUT
                       5 SX=0
                         SXT=0
                         T=-12.5
                         DO 10 I=1,4
                         T=T+5
                         SX=SX+OUT(I)
                      10 SXT=SXT+OUT(I)*T
                         A=SX/4
                         B=SXT/125
                         T=-12.5
                         DO 11 I=1,4
                         T=T+5
                      11 OUT(I)=OUT(I)-A-B*T
                         WRITE(IPT,1002)(OUT(I),I=1,4)
                         RETURN
                    1000 FORMAT(///,4(6X,'T ',I2),3(4X,'GPM ',I2))
                    1001 FORMAT(7F10.3)
                    1002 FORMAT(1X,4(2X,'(',F6.3,')'))
                         END
```

Program Listing A-25   Preprocessor Group Phase Measurement Calculator

```
09/28/76        INPUT LISTING                            AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSQ)

  CARD NO         ****                           CONTENTS                          ****

      1                  SUBROUTINE SHFT(I,J,K)
      2                  CALL SHFTL(I,J,K,L)
      3                  RETURN
      4                  END
```

Program Listing A-26   Preprocessor Logical Shift Caller

```
09/28/76        INPUT LISTING                            AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSQ)

  CARD NO         ****                           CONTENTS                          ****

      1                  SUBROUTINE SHFT1(I,J,K)
      2                  I=0
      3                  CALL SHFTL(I,J,K,L)
      4                  RETURN
      5                  END
```

Program Listing A-27   Preprocessor Clear and Logical Shift Caller

```
09/28/76        INPUT LISTING                            AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR

FORTRAN MODULE      (LIST,NAMSQ)

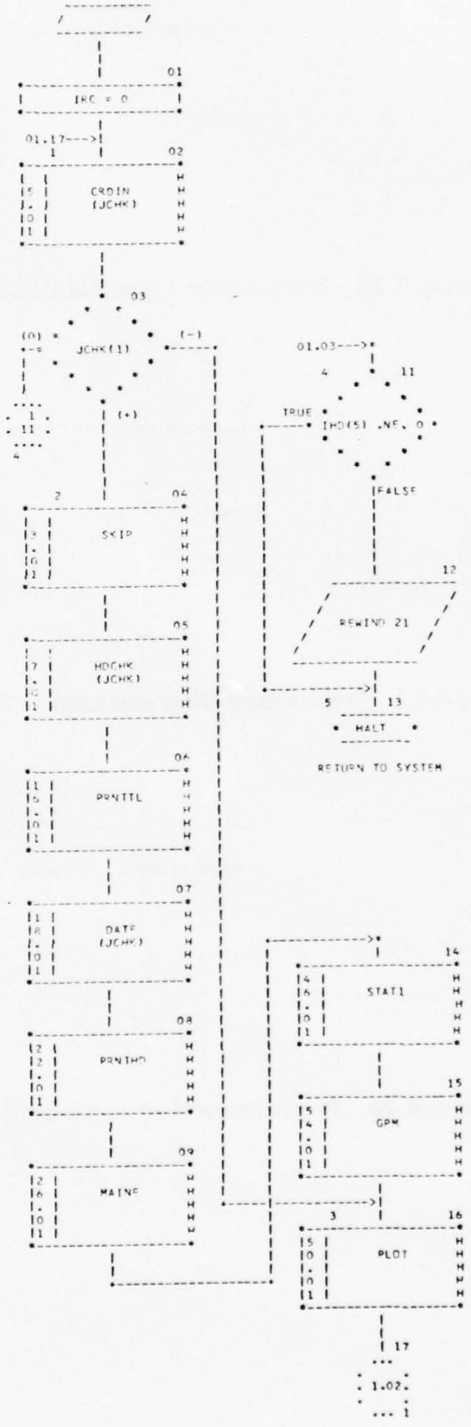
  CARD NO         ****                           CONTENTS                          ****

      1                  SUBROUTINE SHFT2(I,J,K)
      2                  CALL SHFTA(I,J,K,L)
      3                  RETURN
      4                  END
```

Program Listing A-28   Preprocessor Arithmetic Shift Caller

09/26/76 AUTOFLOW CHART SET - LORAN 1 GROUP PHASE PREPROCESSOR PAGE 01

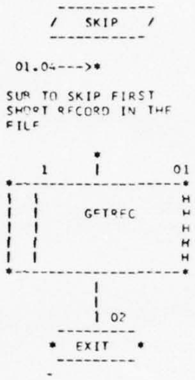
CHART TITLE - PROCEDURES



Flow Chart A-1 Preprocessor Driver

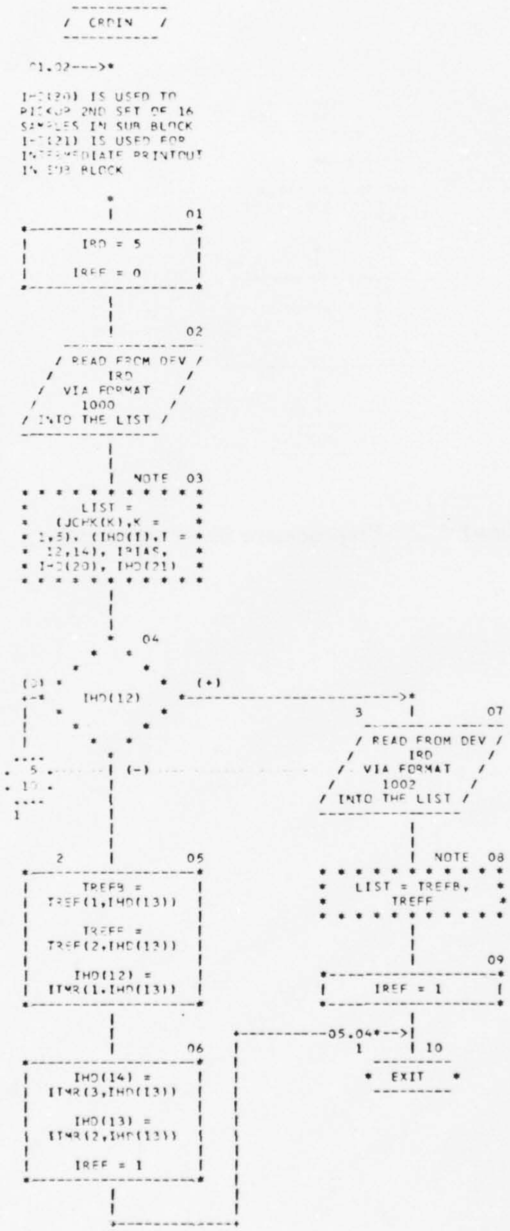
```
09/28/76                                            AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR        PAGE  03

CHART TITLE - SUBROUTINE  SKIP
```

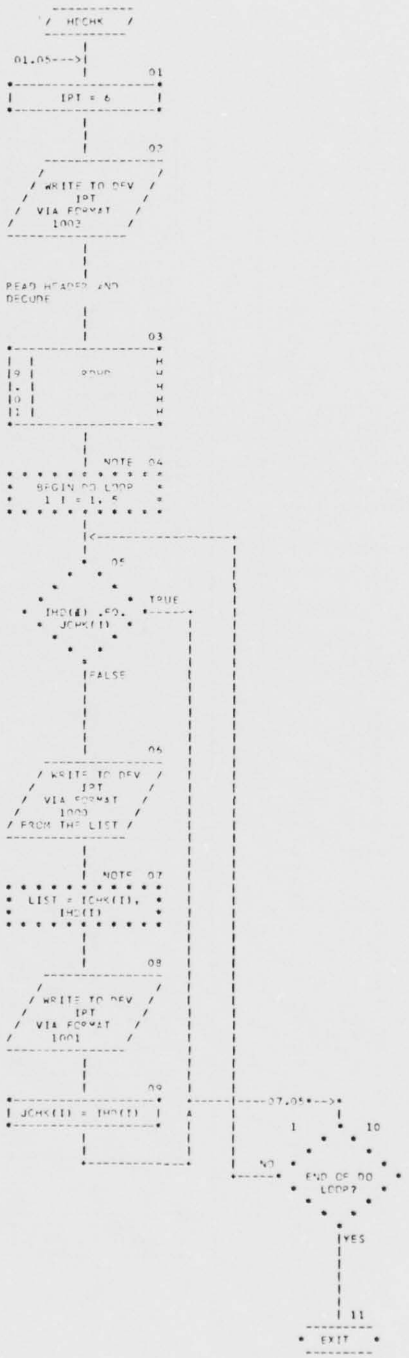


Flow Chart A-2 Preprocessor Short Record Skip

CHART TITLE - SUBROUTINE CRDIN(JCHK)

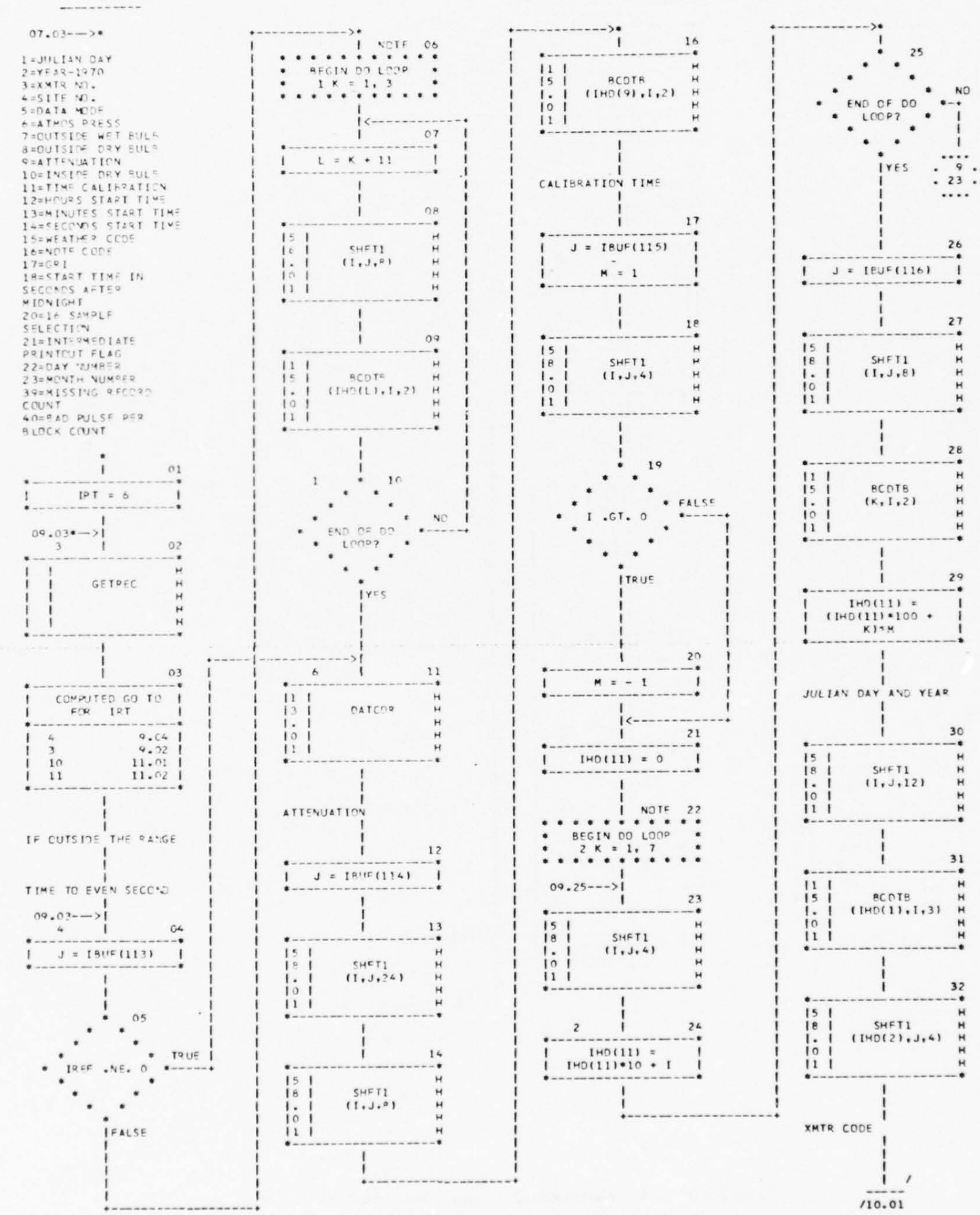


Flow Chart A-3 Preprocessor Initialization



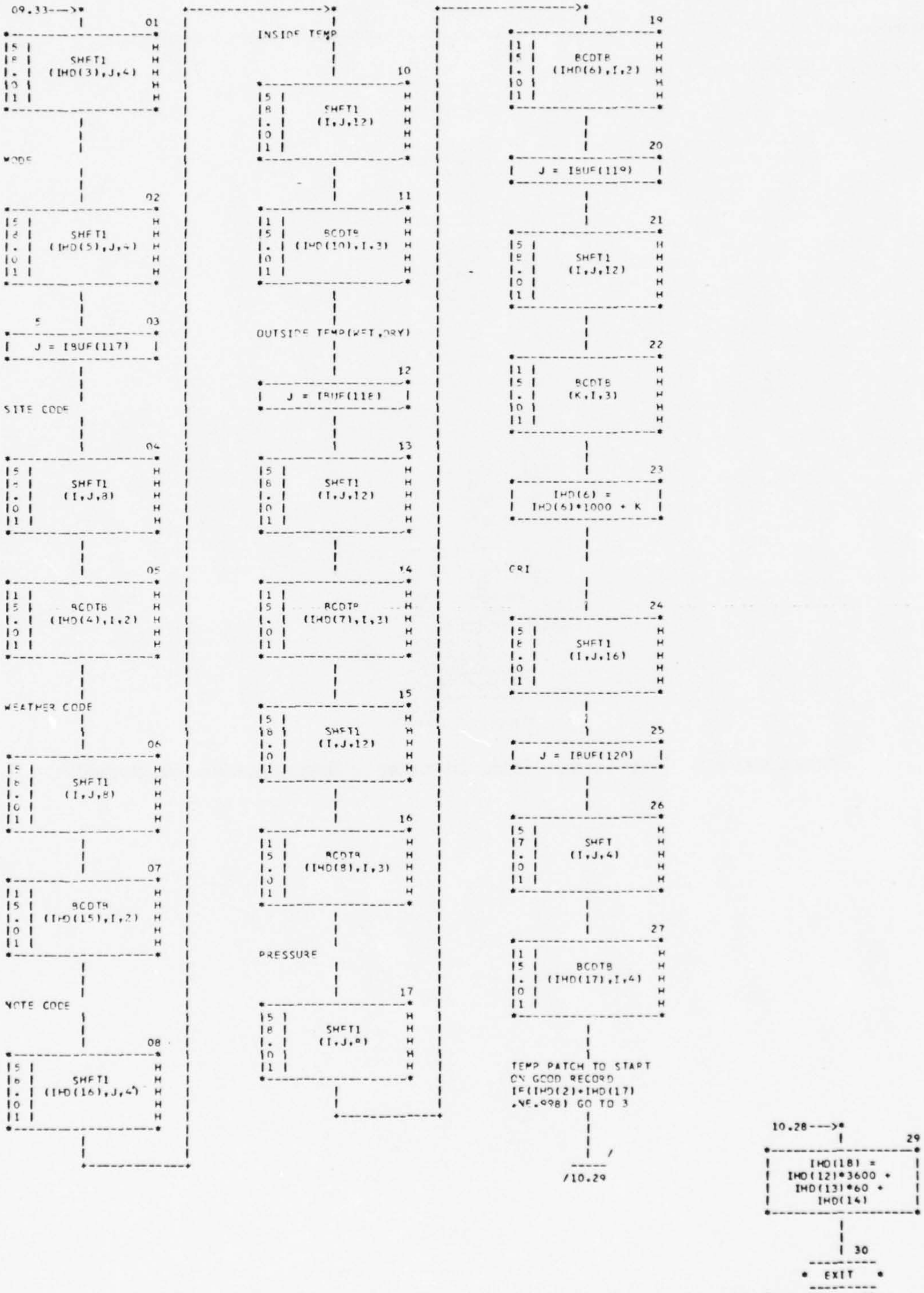
Flow Chart A-4 Preprocessor Header Information Check

CHART TITLE - SUBROUTINE RDHD



Flow Chart A-5 Preprocessor Header Information Decommutator

CHART TITLE - SUBROUTINE RDHD



Flow Chart A-5 Preprocessor Header Information Decommutator (continued)

```
09/28/76                                      AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR        PAGE  11

 CHART TITLE - SUBROUTINE  RDHD



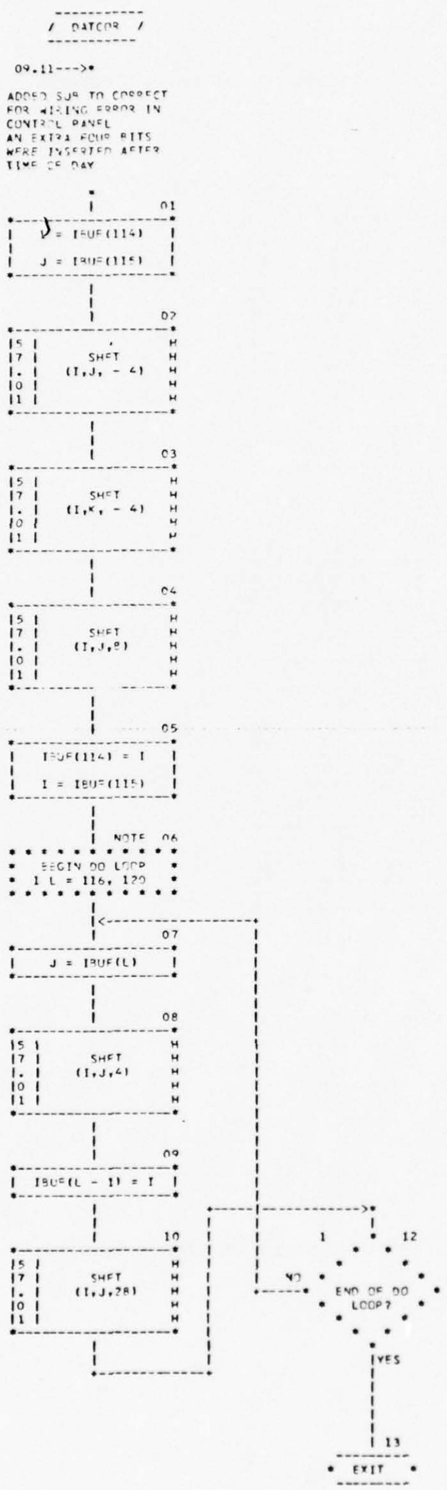
                                          -----------
                                         /    10    /
                                        ----------
                                             |
                                    09.03--->|
                                             |         01
                                        ---------------
                                       /              /
                                      / WRITE TO DEV /
                                     /      IPT     /
                                    /  VIA FORMAT  /
                                   /      1000    /
                                   ---------------
                                             |
                                             |
                                             |
                                            ...
                                          .     .
                                          . 9.02.
                                          .     .
                                            ... 3



                                          -----------
                                         /    11    /
                                        ----------
                                             |
                                    09.03--->|
                                             |         02
                                        ---------------
                                       /              /
                                      / WRITE TO DEV /
                                     /      IPT     /
                                    /  VIA FORMAT  /
                                   /      1001    /
                                   ---------------
                                             |
                                             |
                                             | 03
                                          ---------
                                          * HALT  *
                                          ---------

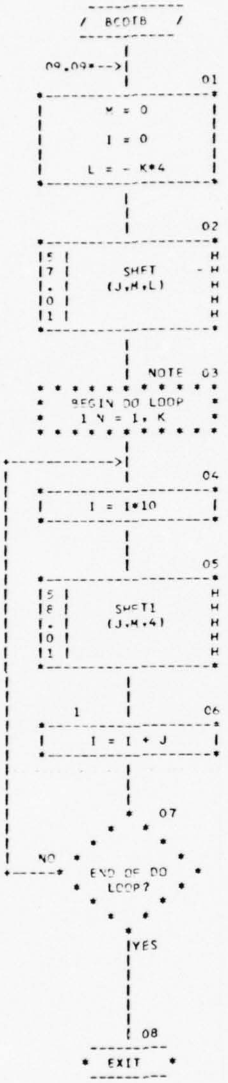
                                      RETURN TO SYSTEM
```

Flow Chart A-5 Preprocessor Header Information Decommutator (concluded)



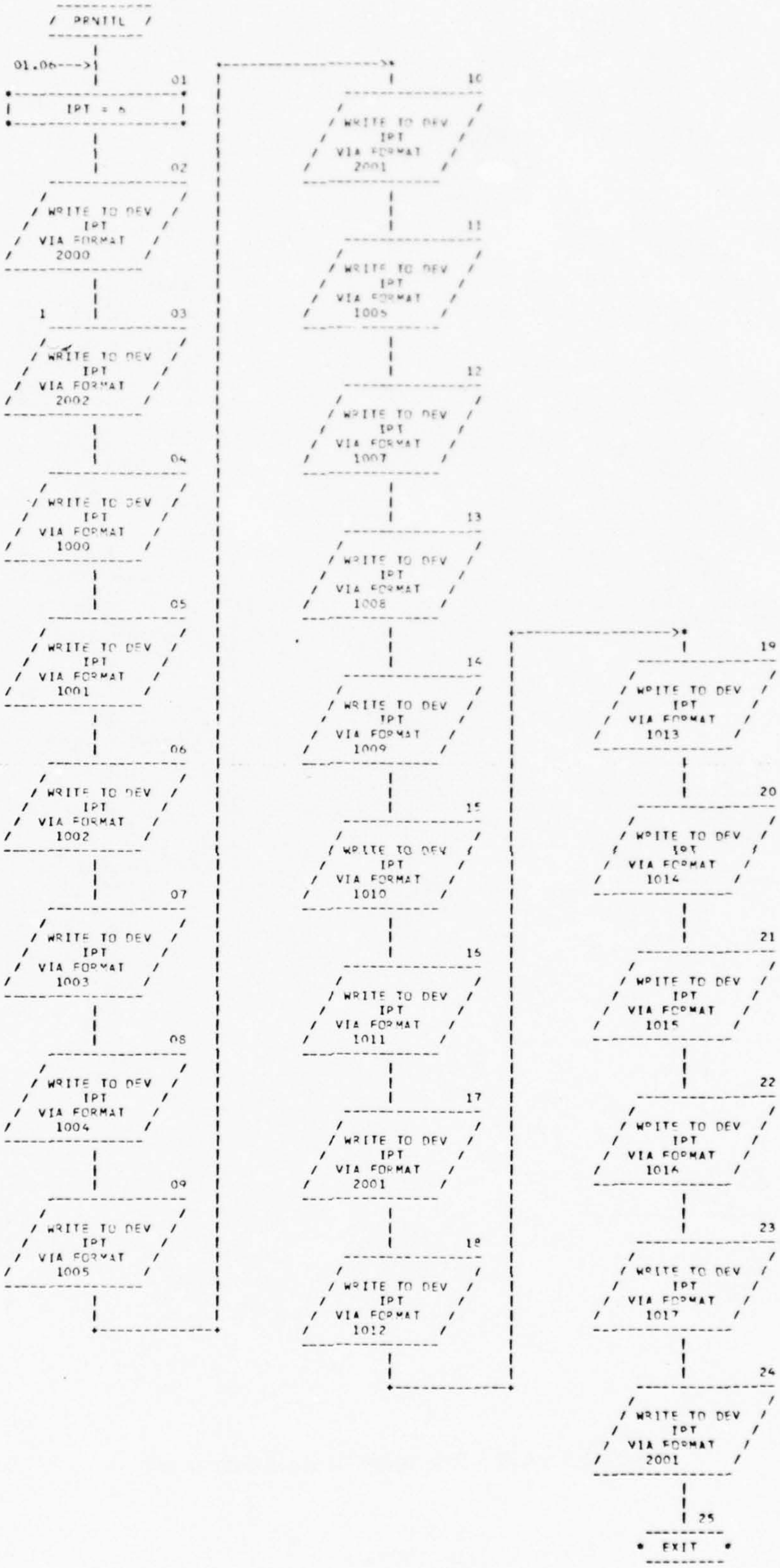
Flow Chart A-6 Preprocessor Data Format Converter

CHART TITLE - SUBROUTINE BCDTB(I,J,K)



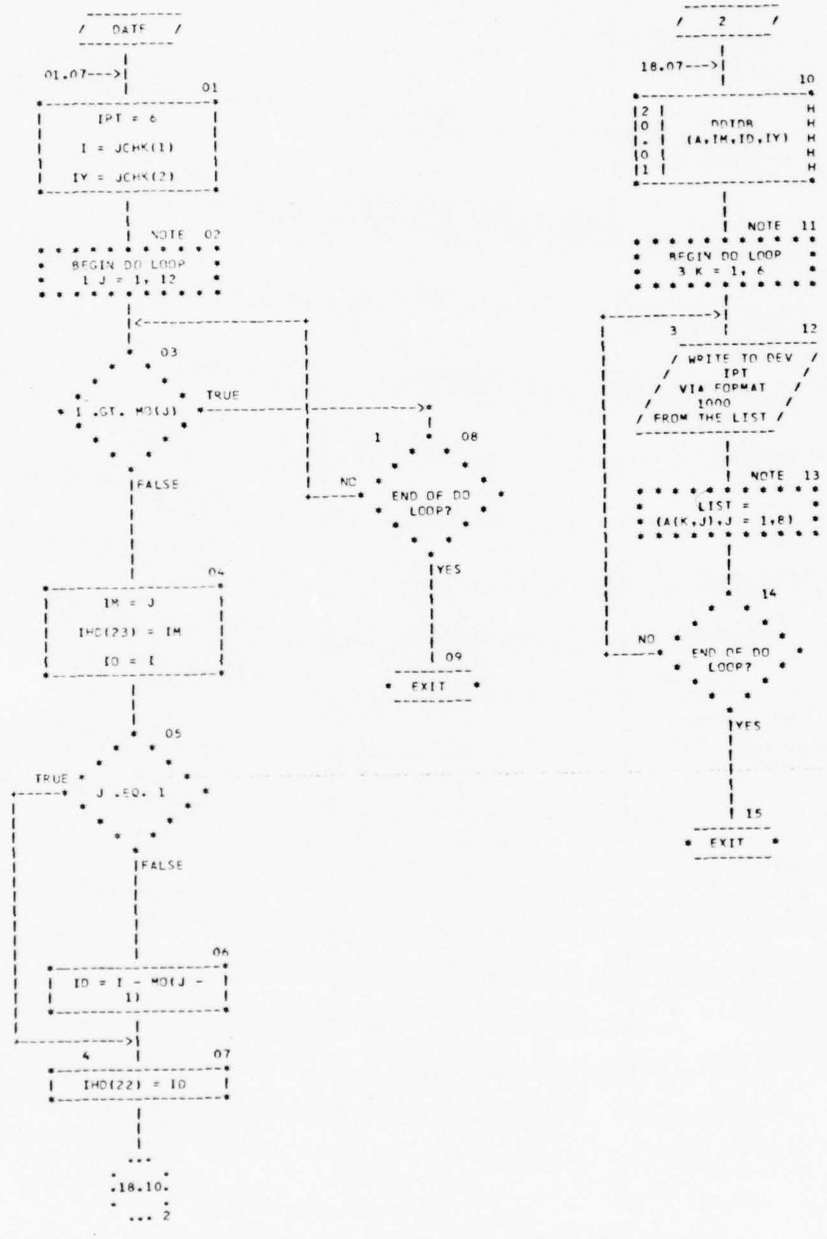
Flow Chart A-7 Preprocessor BCD to Binary Converter

CHART TITLE - SUBROUTINE PRNTTL

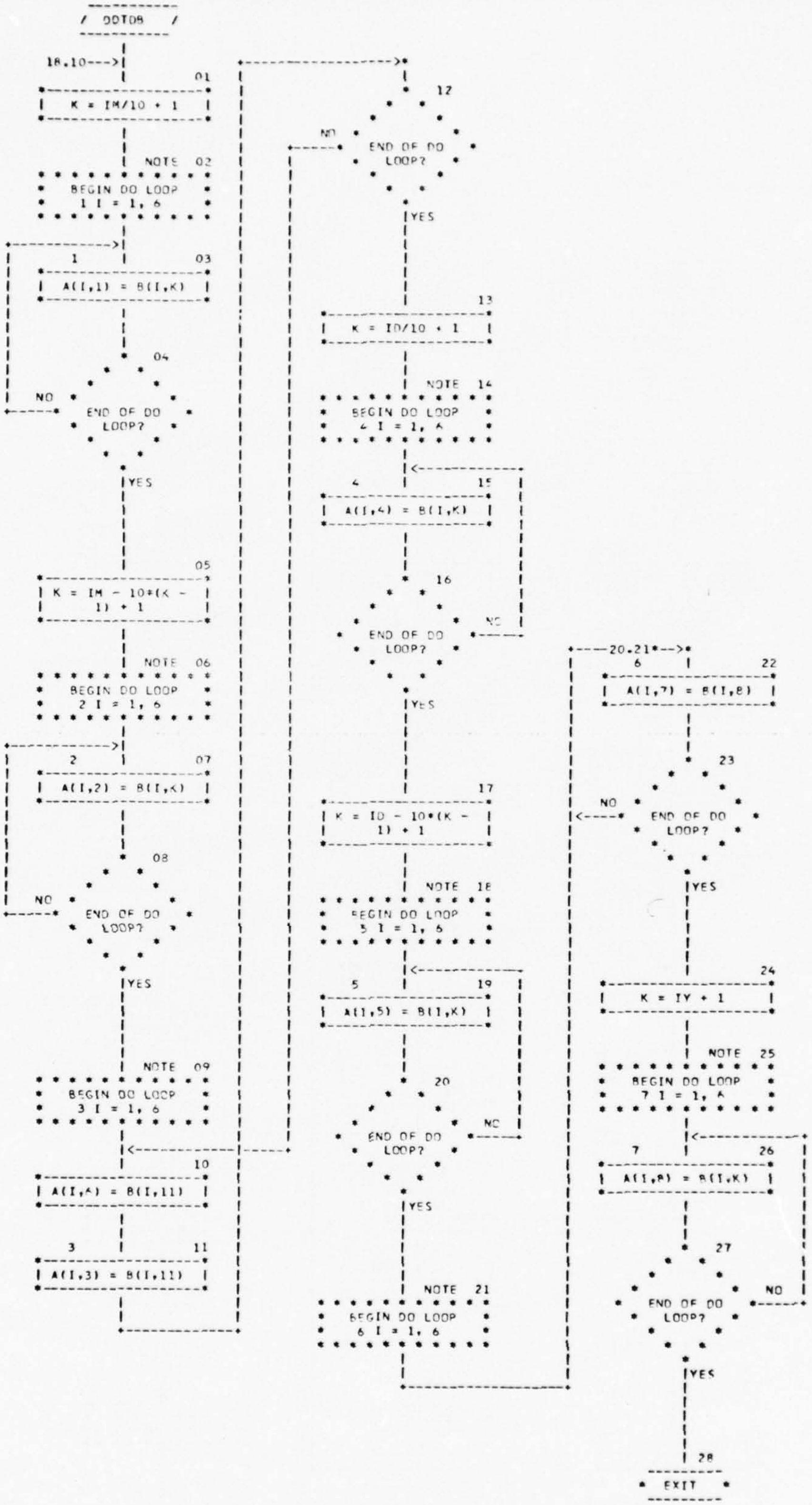

PRNTTL
01.06--->
01
IPT = 6
02
WRITE TO DEV IPT VIA FORMAT 2000
1
03
WRITE TO DEV IPT VIA FORMAT 2002
04
WRITE TO DEV IPT VIA FORMAT 1000
05
WRITE TO DEV IPT VIA FORMAT 1001
06
WRITE TO DEV IPT VIA FORMAT 1002
07
WRITE TO DEV IPT VIA FORMAT 1003
08
WRITE TO DEV IPT VIA FORMAT 1004
09
WRITE TO DEV IPT VIA FORMAT 1005
10
WRITE TO DEV IPT VIA FORMAT 2001
11
WRITE TO DEV IPT VIA FORMAT 1006
12
WRITE TO DEV IPT VIA FORMAT 1007
13
WRITE TO DEV IPT VIA FORMAT 1008
14
WRITE TO DEV IPT VIA FORMAT 1009
15
WRITE TO DEV IPT VIA FORMAT 1010
16
WRITE TO DEV IPT VIA FORMAT 1011
17
WRITE TO DEV IPT VIA FORMAT 2001
18
WRITE TO DEV IPT VIA FORMAT 1012
19
WRITE TO DEV IPT VIA FORMAT 1013
20
WRITE TO DEV IPT VIA FORMAT 1014
21
WRITE TO DEV IPT VIA FORMAT 1015
22
WRITE TO DEV IPT VIA FORMAT 1016
23
WRITE TO DEV IPT VIA FORMAT 1017
24
WRITE TO DEV IPT VIA FORMAT 2001
25
EXIT

Flow Chart A-8 Preprocessor Title Page Printer

CHART TITLE - SUBROUTINE DATE(JCHK)

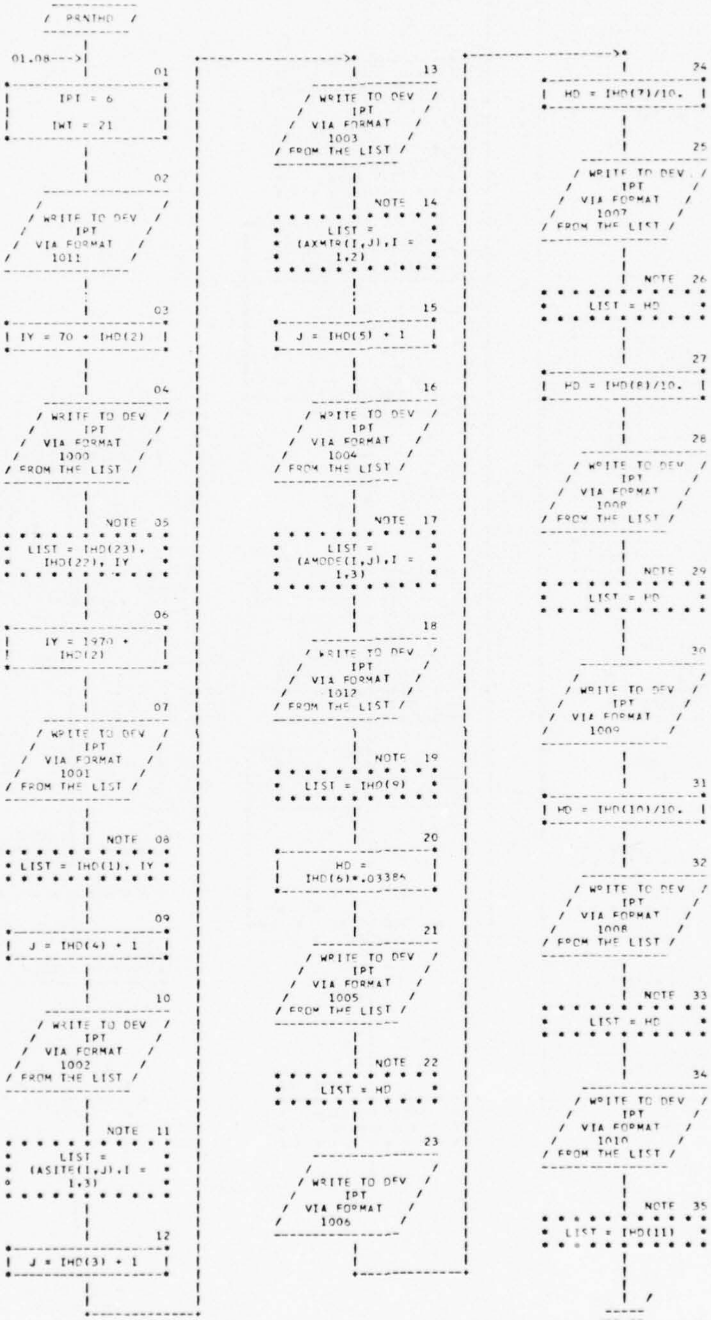


Flow Chart A-9 Preprocessor Date Converter



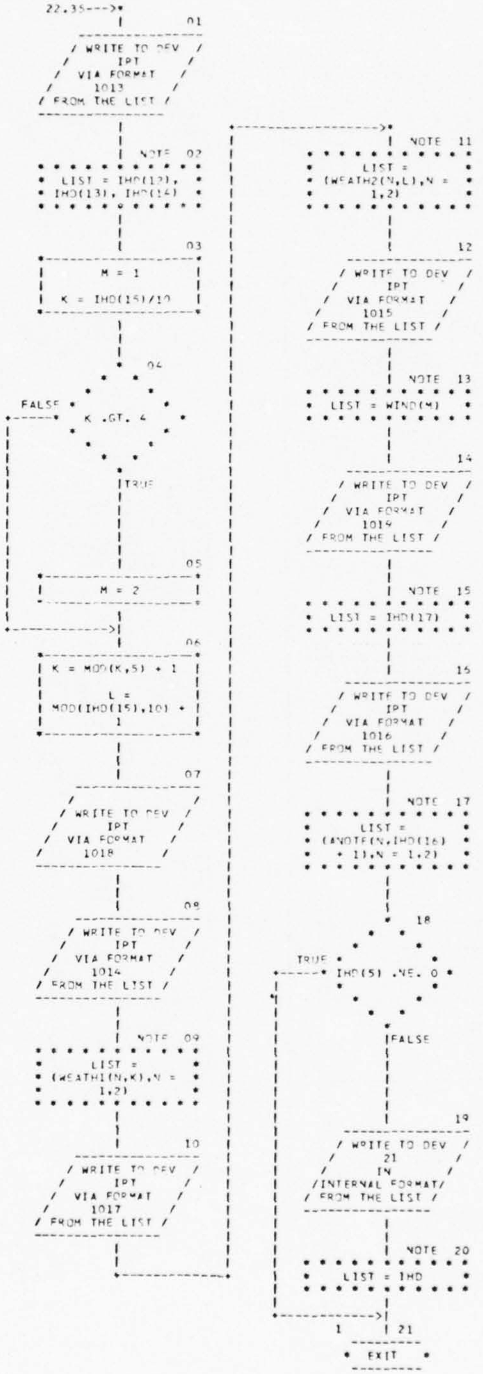
Flow Chart A-10 Preprocessor Title Page Date Formatter

CHART TITLE - SUBROUTINE PRNTHD


PRNTHD
01.08--->
01
IPT = 6
IWT = 21
02
WRITE TO DEV IPT VIA FORMAT 1011
03
IY = 70 + IHD(2)
04
WRITE TO DEV IPT VIA FORMAT 1000 FROM THE LIST
NOTE 05
LIST = IHD(23), IHD(22), IY
06
IY = 1970 + IHD(2)
07
WRITE TO DEV IPT VIA FORMAT 1001 FROM THE LIST
NOTE 08
LIST = IHD(1), IY
09
J = IHD(4) + 1
10
WRITE TO DEV IPT VIA FORMAT 1002 FROM THE LIST
NOTE 11
LIST = (ASITE(I,J),I = 1,3)
12
J = IHD(3) + 1
13
WRITE TO DEV IPT VIA FORMAT 1003 FROM THE LIST
NOTE 14
LIST = (AXMTR(I,J),I = 1,2)
15
J = IHD(5) + 1
16
WRITE TO DEV IPT VIA FORMAT 1004 FROM THE LIST
NOTE 17
LIST = (AMODE(I,J),I = 1,3)
18
WRITE TO DEV IPT VIA FORMAT 1012 FROM THE LIST
NOTE 19
LIST = IHD(9)
20
HD = IHD(6)*.03386
21
WRITE TO DEV IPT VIA FORMAT 1005 FROM THE LIST
NOTE 22
LIST = HD
23
WRITE TO DEV IPT VIA FORMAT 1006
24
HD = IHD(7)/10.
25
WRITE TO DEV IPT VIA FORMAT 1007 FROM THE LIST
NOTE 26
LIST = HD
27
HD = IHD(8)/10.
28
WRITE TO DEV IPT VIA FORMAT 1008 FROM THE LIST
NOTE 29
LIST = HD
30
WRITE TO DEV IPT VIA FORMAT 1009
31
HD = IHD(10)/10.
32
WRITE TO DEV IPT VIA FORMAT 1008 FROM THE LIST
NOTE 33
LIST = HD
34
WRITE TO DEV IPT VIA FORMAT 1010 FROM THE LIST
NOTE 35
LIST = IHD(11)
/23.01

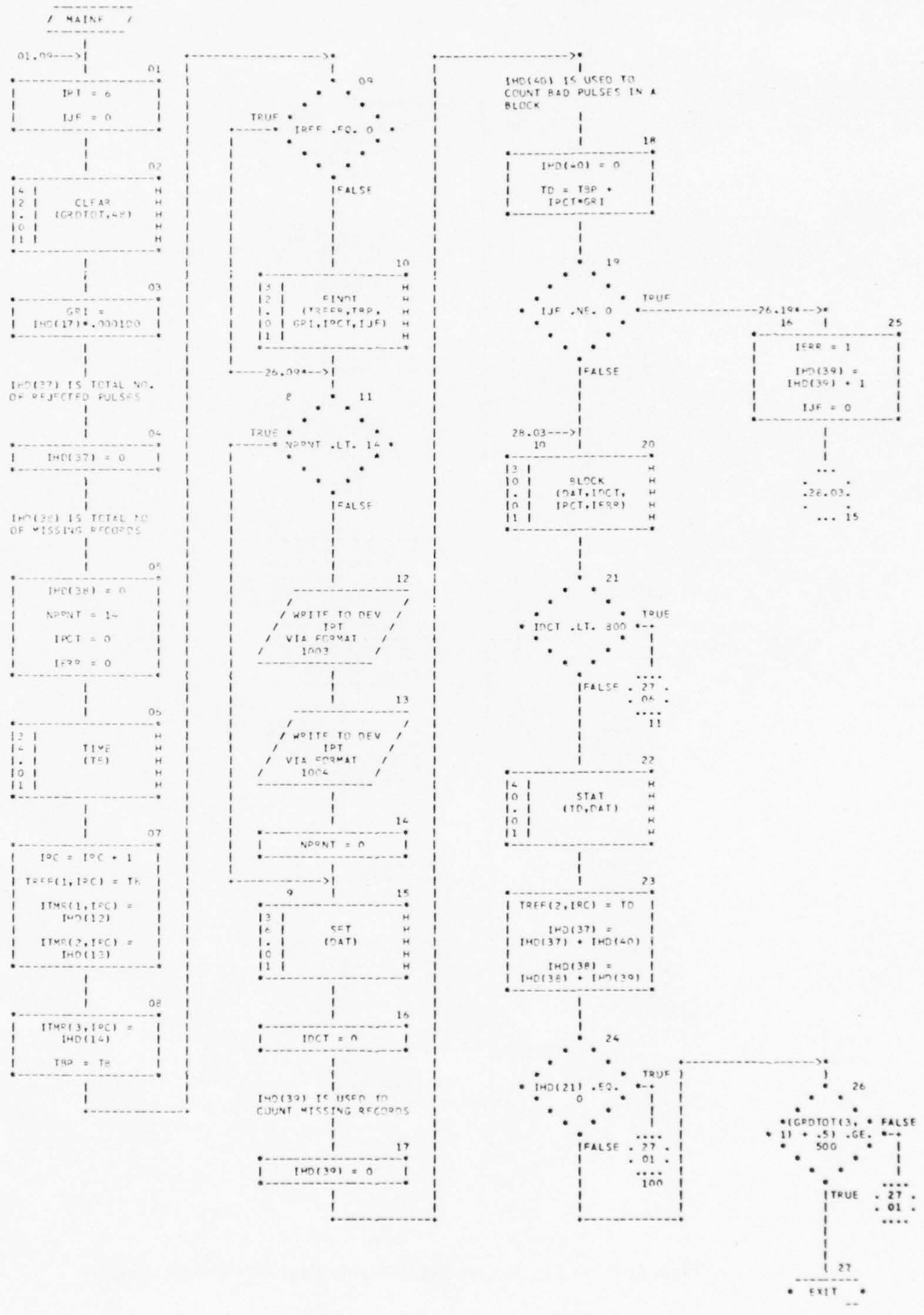
Flow Chart A-11 Preprocessor Header Page Printer

CHART TITLE - SUBROUTINE PRNTHD

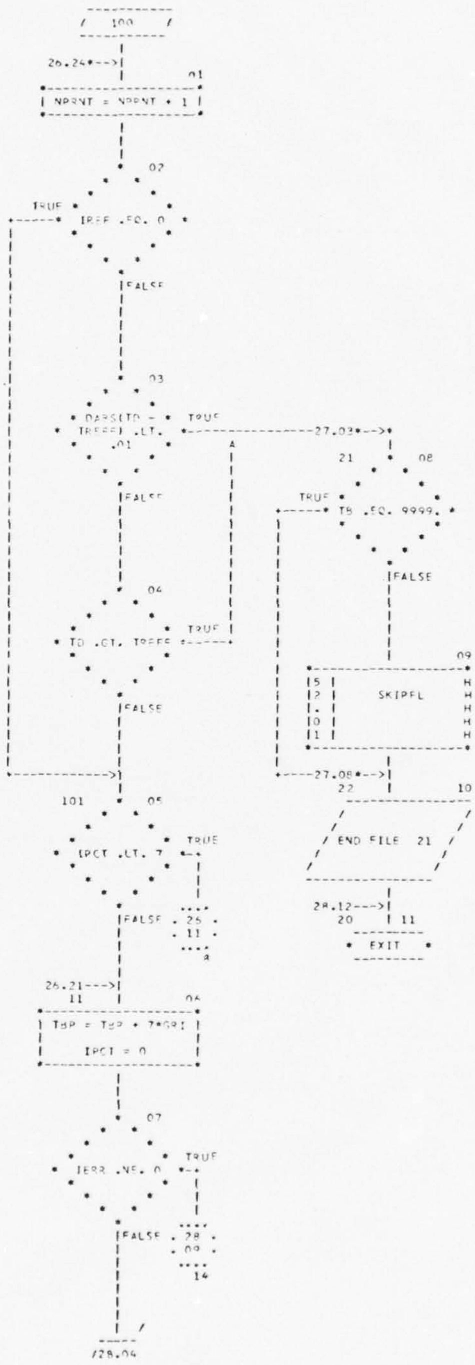

22,35--->
01
WRITE TO DEV IPT VIA FORMAT 1013 FROM THE LIST
NOTE 02
LIST = IHD(12), IHD(13), IHD(14)
03
M = 1
K = IHD(15)/10
04
FALSE
K .GT. 4
TRUE
05
M = 2
06
K = MOD(K,5) + 1
L = MOD(IHD(15),10) + 1
07
WRITE TO DEV IPT VIA FORMAT 1018
08
WRITE TO DEV IPT VIA FORMAT 1014 FROM THE LIST
NOTE 09
LIST = (WEATH1(N,K),N = 1,2)
10
WRITE TO DEV IPT VIA FORMAT 1017 FROM THE LIST
NOTE 11
LIST = (WEATH2(N,L),N = 1,2)
12
WRITE TO DEV IPT VIA FORMAT 1015 FROM THE LIST
NOTE 13
LIST = WIND(M)
14
WRITE TO DEV IPT VIA FORMAT 1019 FROM THE LIST
NOTE 15
LIST = IHD(17)
16
WRITE TO DEV IPT VIA FORMAT 1016 FROM THE LIST
NOTE 17
LIST = (ANOTE(N,IHD(16) + 1),N = 1,2)
18
TRUE
IHD(5) .NE. 0
FALSE
19
WRITE TO DEV 21 IN INTERNAL FORMAT FROM THE LIST
NOTE 20
LIST = IHD
1
21
EXIT

Flow Chart A-11 Preprocessor Header Page Printer (concluded)

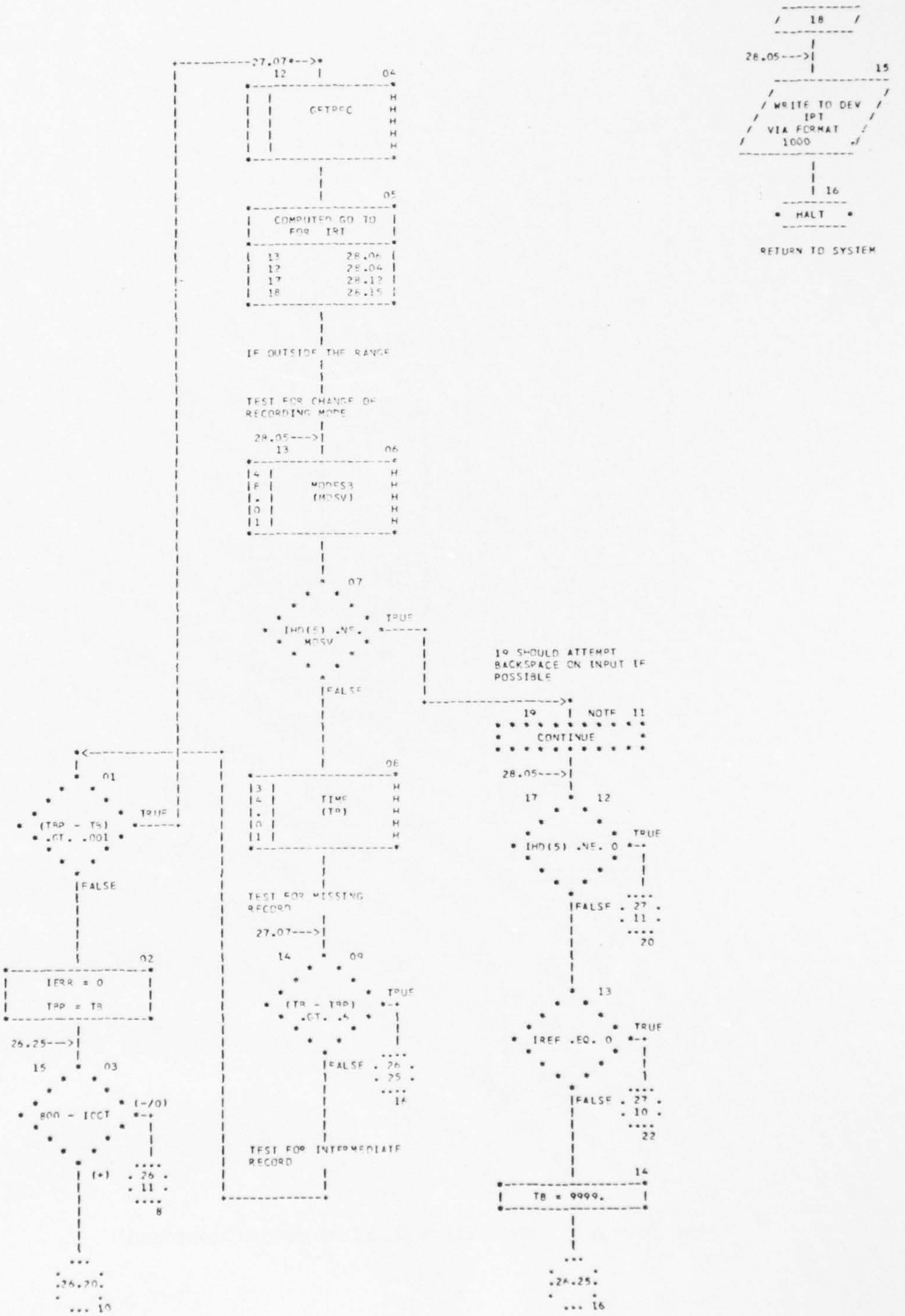
CHART TITLE - SUBROUTINE MAINE



Flow Chart A-12 Preprocessor Main Data Handler

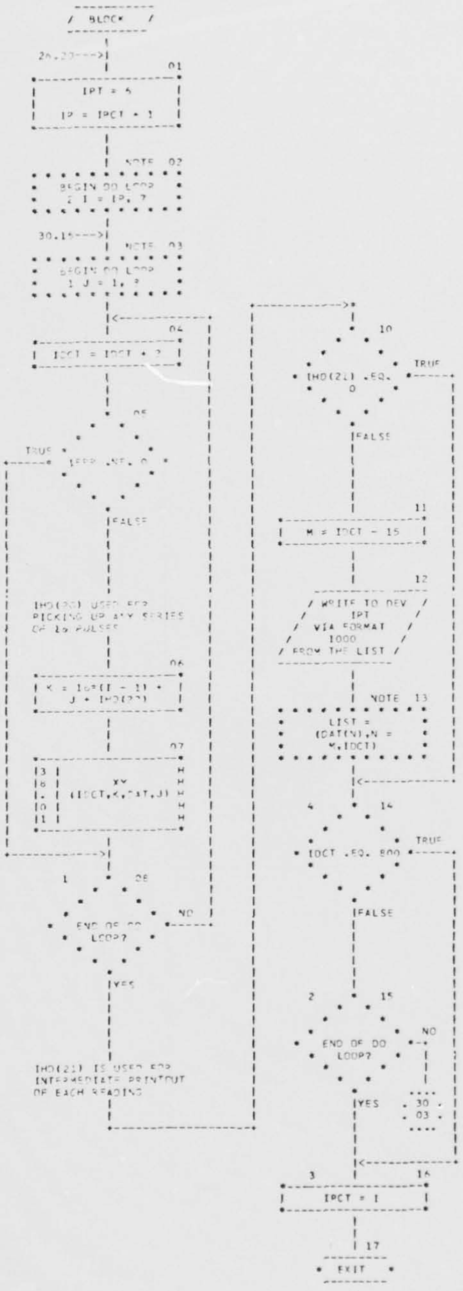


Flow Chart A-12 Preprocessor Main Data Handler (continued)



Flow Chart A-12 Preprocessor Main Data Handler (concluded)

CHART TITLE - SUBROUTINE BLOCK(DAT,IDCT,IPCT,IERR)



Flow Chart A-13 Preprocessor Data Blocker

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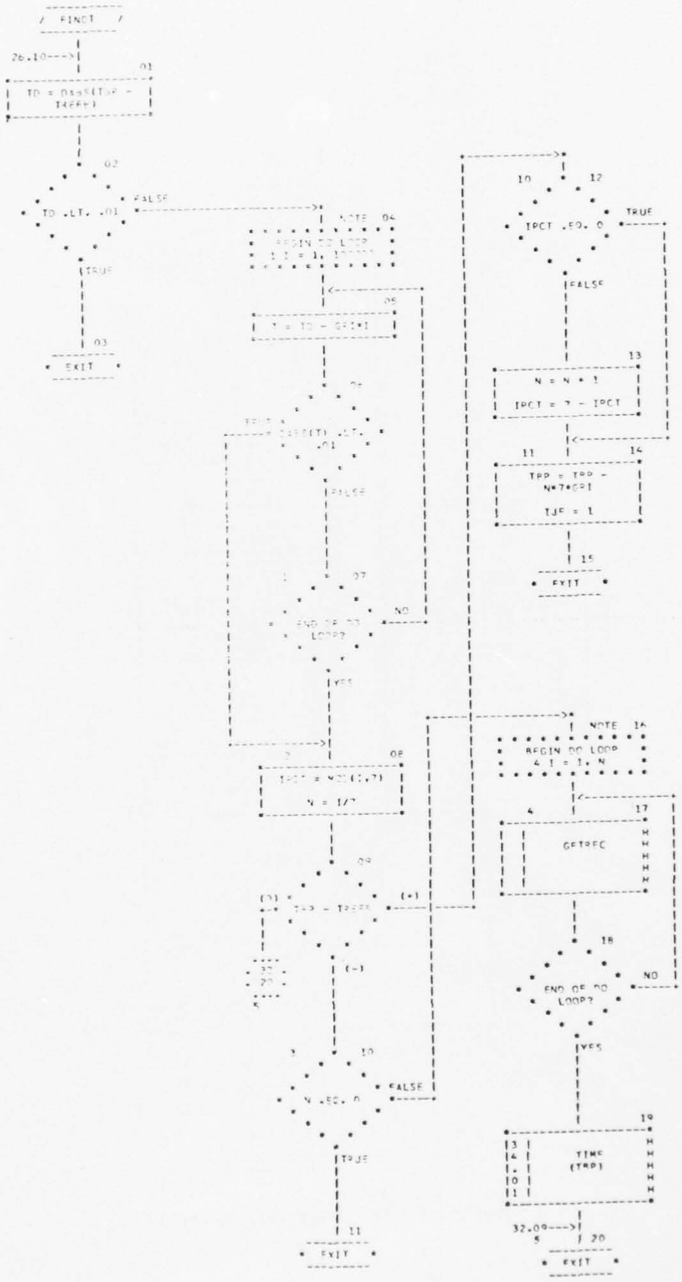
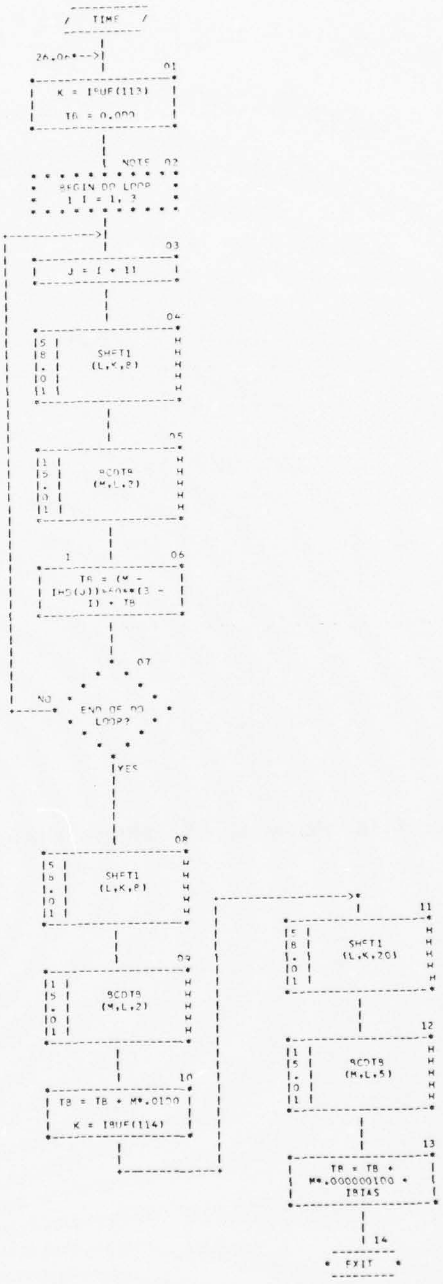
CHART TITLE - SUBROUTINE FINDT(T,[illegible],TRP,GRI,IPCT,IJF)



Flow Chart A-14 Preprocessor Pulse Time Locater

CHART TITLE - SUBROUTINE TIME(IA)



Flow Chart A-15 Preprocessor Time Decoder

```
09/28/76                                   AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR        PAGE  36

CHART TITLE - SUBROUTINE  SET(DAT)


                              -----------
                             /   SET    /
                             -----------
                                  |
                        26.15--->|
                                  |  NOTE  01
                        * * * * * * * * * * * *
                        *   BEGIN DO LOOP     *
                        *    1 I = 1, 800     *
                        * * * * * * * * * * * *
                                  |
                    *------------>|
                    |     1       |          02
                    |   *-------------------*
                    |   |  DAT(I) = 9999.   |
                    |   *-------------------*
                    |             |
                    |             |
                    |             *     03
                    |          *     *
                    |       *           *
                    |  NO *                *
                    *-----*   END OF DO      *
                          *    LOOP?      *
                            *           *
                               *     *
                                  *
                                  |YES
                                  |
                                  |
                                  |
                                  |  04
                              ---------
                              *  EXIT  *
                              ---------
```

Flow Chart A-16   Preprocessor Data Block Initializer

```
09/28/76                                              AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR        PAGE  38

 CHART TITLE - SUBROUTINE  XY(IDCT,K,DAT,L)


                              -----------
                             /    XY     /
                            -----------
                                 |
                       30.07--->|
                                 |          01
                       *-------------------*
                       |    I = IBUF(K)    |
                       *-------------------*
                                 |
                                 |
                                 |          02
                       *-------------------*
                       |5 |                H
                       |8 |     SHFT1      H
                       |. |   (J,I,32)     H
                       |0 |                H
                       |1 |                H
                       *-------------------*
                                 |
                                 |
                                 |          03
                       *-------------------*
                       |5 |                H
                       |9 |     SHFT2      H
                       |. |  (J,I, - 16)   H
                       |0 |                H
                       |1 |                H
                       *-------------------*
                                 |
                                 |
                                 |          04
                       *-------------------*
                       |  DAT(IDCT - 1) =  |
                       |  J*1.2208375E-3   |
                       *-------------------*
                                 |
                                 |
                                 |          05
                       *-------------------*
                       |5 |                H
                       |8 |     SHFT1      H
                       |. |   (J,I,32)     H
                       |0 |                H
                       |1 |                H
                       *-------------------*
                                 |
                                 |
                                 |          06
                       *-------------------*
                       |5 |                H
                       |9 |     SHFT2      H
                       |. |  (J,I, - 16)   H
                       |0 |                H
                       |1 |                H
                       *-------------------*
                                 |
                                 |
                                 |          07
                       *-------------------*
                       |    DAT(IDCT) =    |
                       |  J*1.2208375E-3   |
                       *-------------------*
                                 |
                                 |
                                 |          08
                       *-------------------*
                       |4 |                H
                       |4 |     EDIT       H
                       |. | (IDCT,DAT,L)   H
                       |0 |                H
                       |1 |                H
                       *-------------------*
                                 |
                                 |
                                 | 09
                             ----------
                             *  EXIT  *
                             ----------
```

Flow Chart A-17 Preprocessor Measurement Decoder

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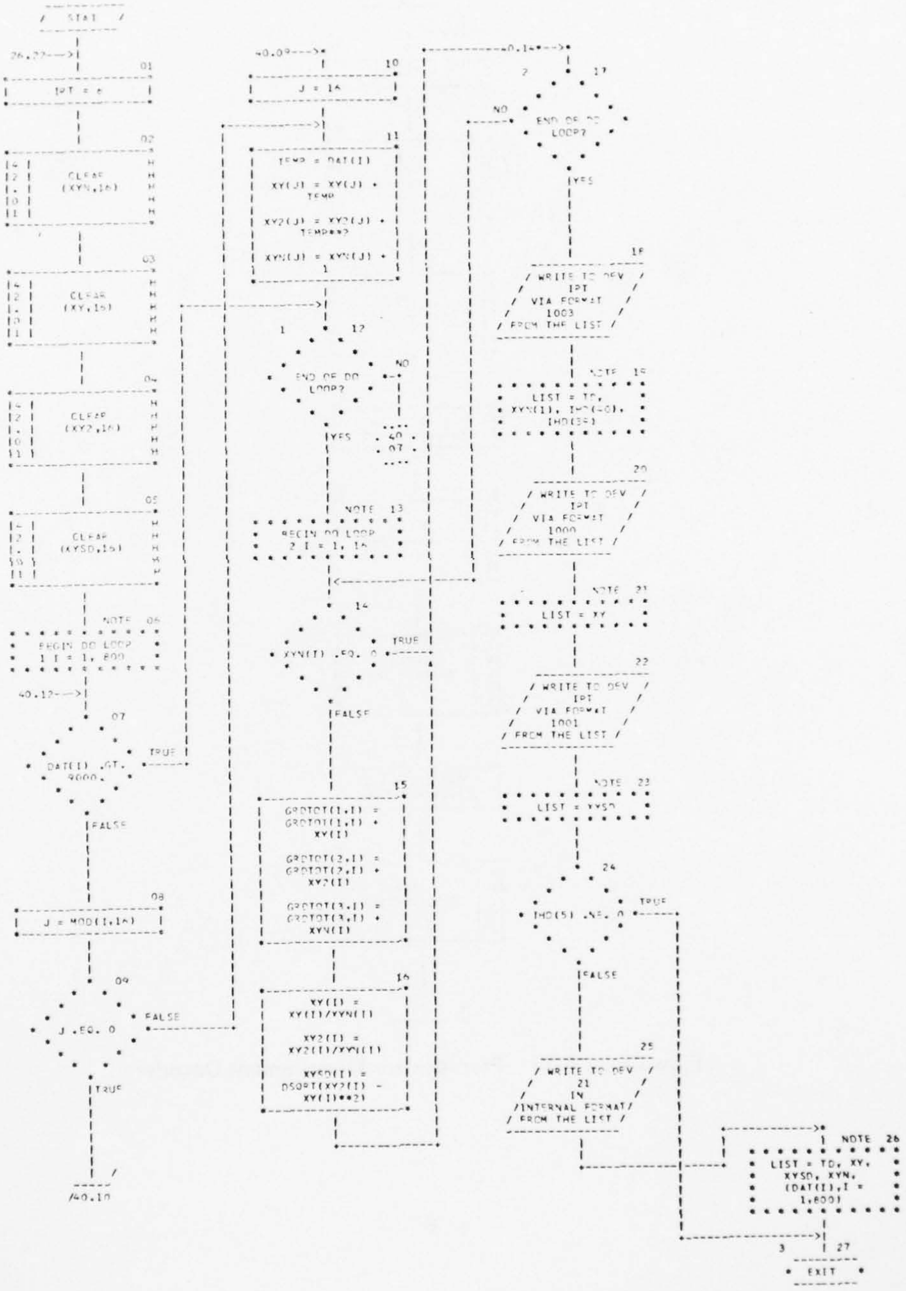
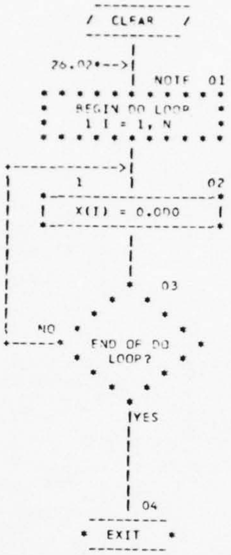
CHART TITLE - SUBROUTINE STAT(TD,DAT)



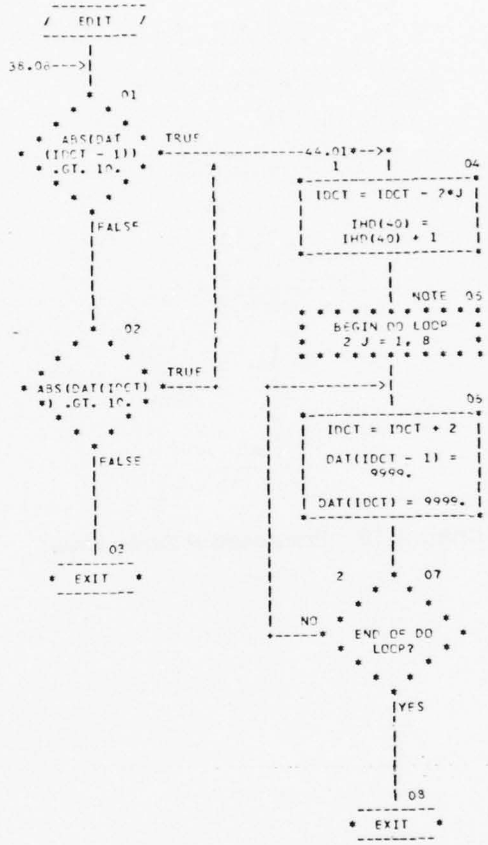
Flow Chart A-18 Preprocessor Intermediate Statistics

CHART TITLE - SUBROUTINE CLEAR(X,N)



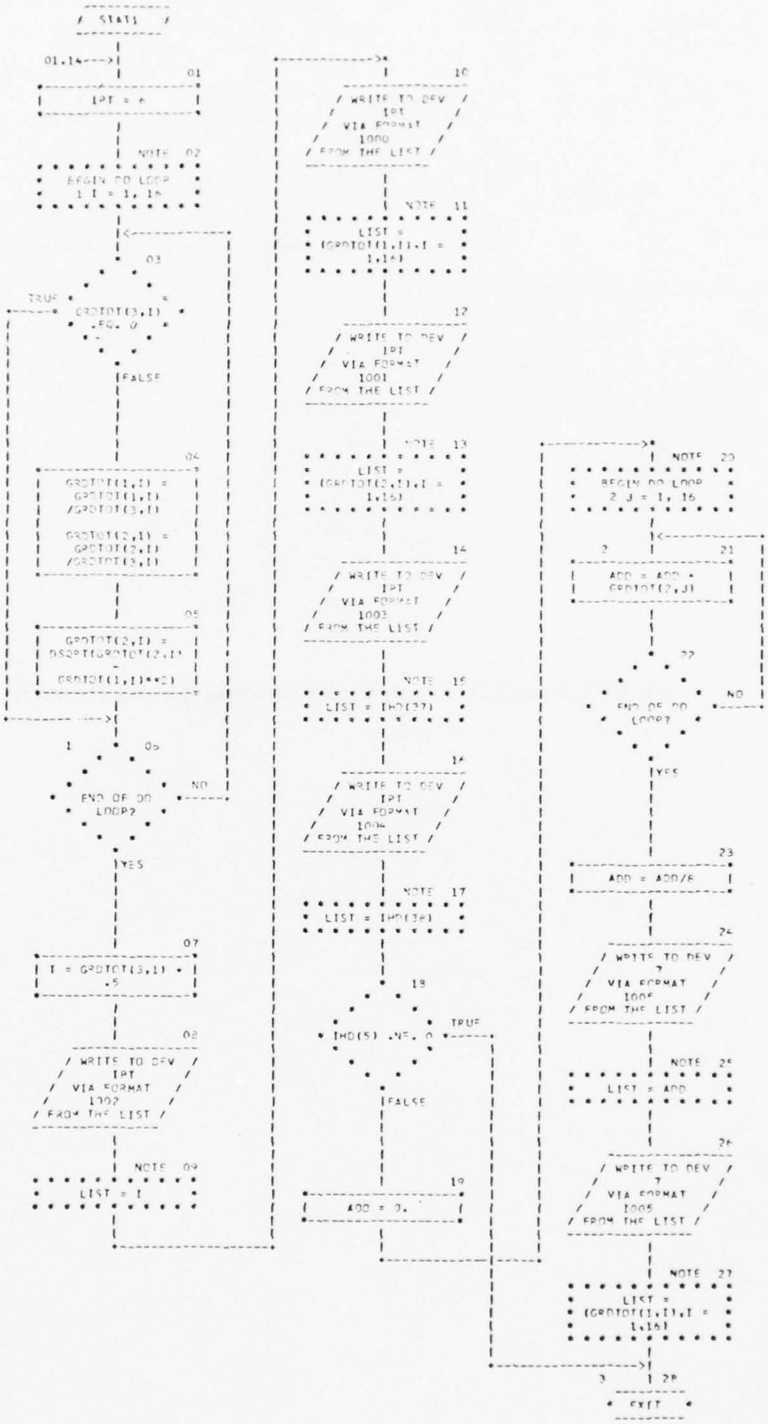
Flow Chart A-19 Preprocessor Array Reset

CHART TITLE - SUBROUTINE EDIT(IDCT,DAT,J)



Flow Chart A-20 Preprocessor First-Stage Editor

CHART TITLE - SUBROUTINE STAT1



Flow Chart A-21 Preprocessor Final Statistics

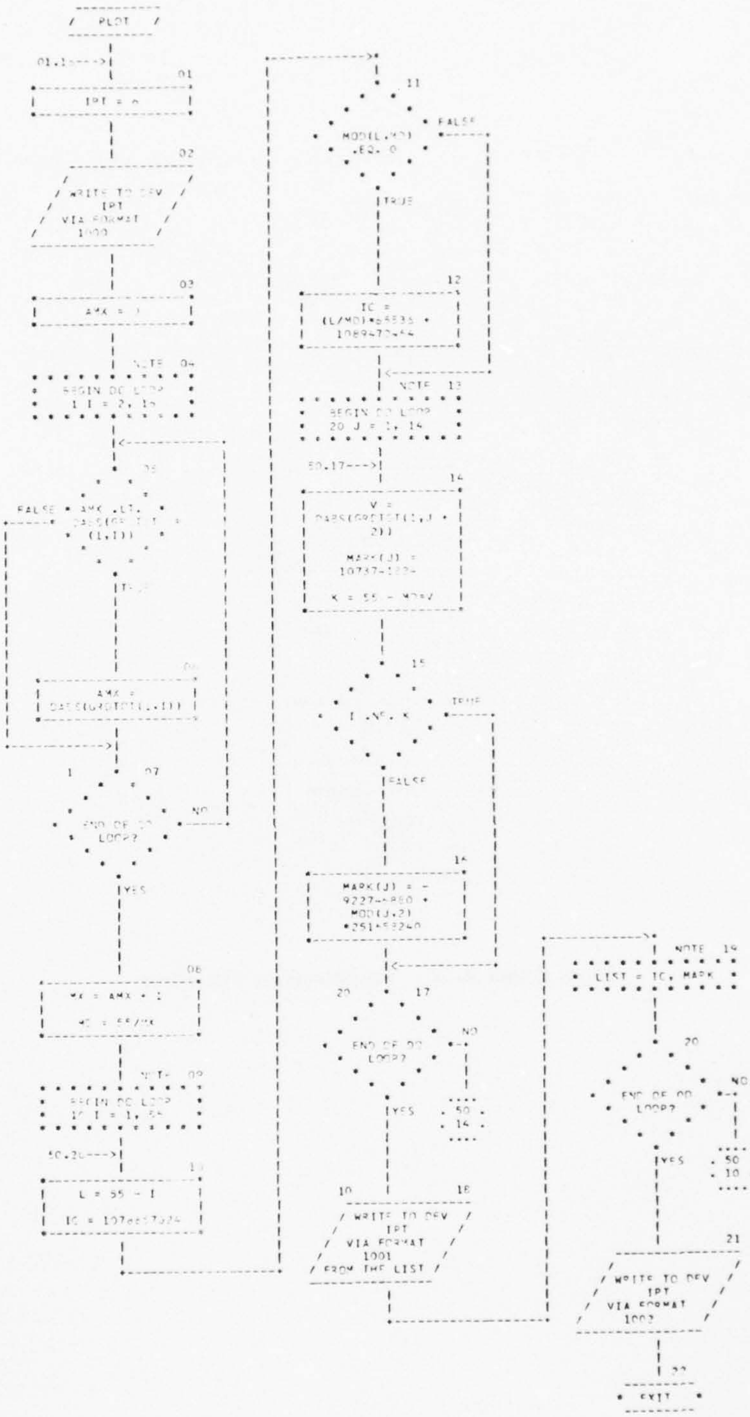
```
09/28/76                                  AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR        PAGE  48

CHART TITLE - SUBROUTINE  MODESB(MDSV)


                   -----------
                  /  MODESB   /
                  -----------
                       |
             28.06--->|
                       |              01
           *-----------------------*
           |5 |                    H
           |8 |      SHFT1         H
           |. |      (MDSV,        H
           |0 |   IBUF(117),4)     H
           |1 |                    H
           *-----------------------*
                       |
                       |
                       | 02
                   ---------
                  *  EXIT   *
                   ---------
```

Flow Chart A-22   Preprocessor Recording Mode Decoder

CHART TITLE - SUBROUTINE PLOT



Flow Chart A-23 Preprocessor Plotter

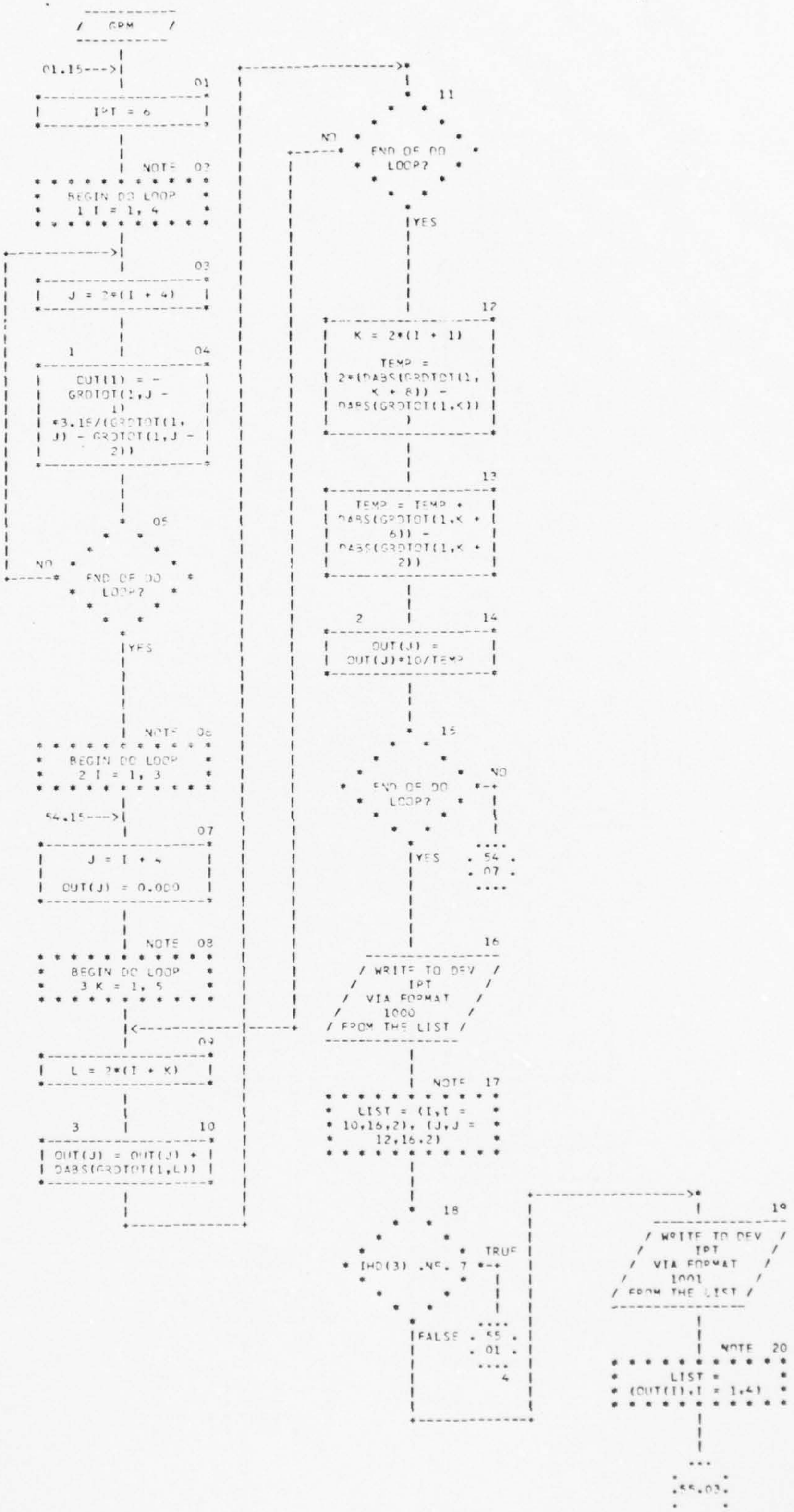
```
09/29/76                                  AUTOFLOW CHART SET - LORAN 1  GROUP PHASE PREPROCESSOR        PAGE  52

 CHART TITLE - SUBROUTINE  SKIPFL


                            -----------
                           /    1     /
                          -----------
                                |
                      27.09*--->|
                                |                01
                      *-------------------------*
                      | |                       H
                      | |       GETREC          H
                      | |                       H
                      | |                       H
                      | |                       H
                      *-------------------------*
                                |
                                |
                                |                02
                      *-------------------------*
                      |    COMPUTED GO TO       |
                      |       FOR  IRT          |
                      *-------------------------*
                      |  1              52.01   |
                      |  1              52.01   |
                      |  3              52.04   |
                      |  2              52.03   |
                      *-------------------------*
                                |
                                |
                                |
                      IF OUTSIDE THE RANGE
                                |
                       52.02--->|
                          2     |                03
                          ---------------------
                         /                    /
                        / WRITE TO DEV       /
                       /        5           /
                      /  VIA FORMAT        /
                     /     1000           /
                     ---------------------
                                |
                       52.02--->|
                          3     | 04
                           ---------
                          *  EXIT   *
                           ---------
```

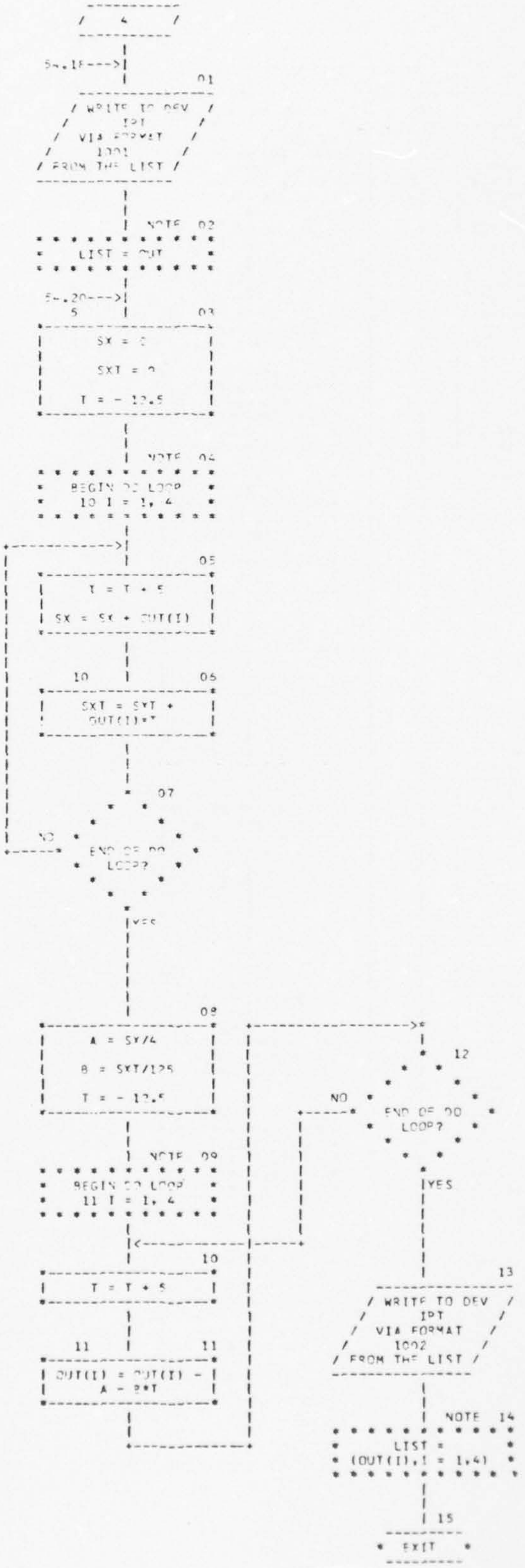
Flow Chart A-24   Preprocessor File Skip

CHART TITLE - SUBROUTINE GPM



Flow Chart A-25 Preprocessor Group Phase Measurement Calculator

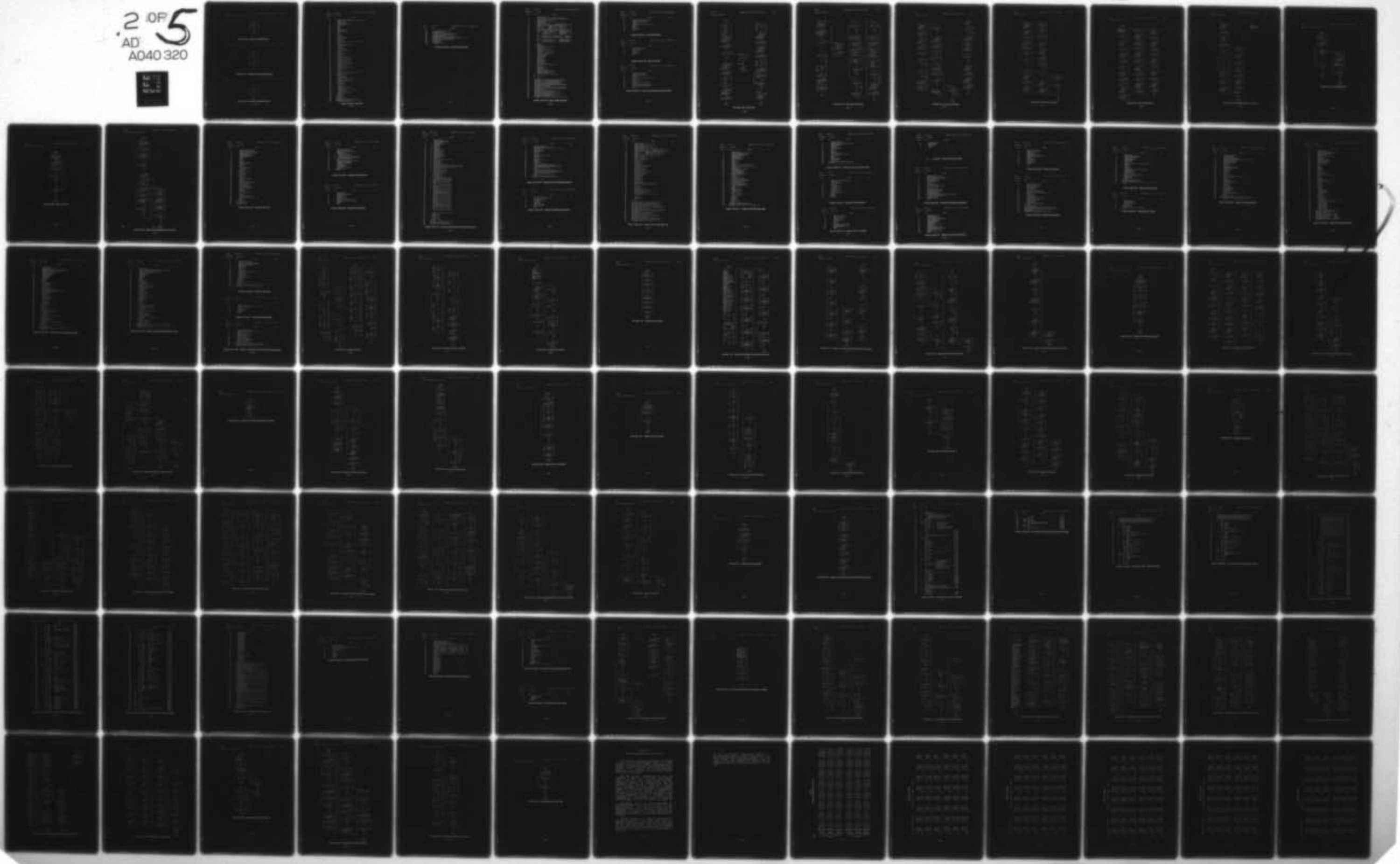
CHART TITLE - SUBROUTINE GPM



Flow Chart A-25 Preprocessor Group Phase Measurement Calculator (concluded)

AD-A040 320 JOHNS HOPKINS UNIV LAUREL MD APPLIED PHYSICS LAB F/G 17/7
EXPERIMENTAL RESEARCH ON THE PROPAGATION OF LORAN-C SIGNALS. VO--ETC(U)
JAN 77 L F FEHLNER, T W JERARDI, T A MCCARTY N00017-72-C-4401
UNCLASSIFIED APL/JHU-TG-1298D NL

2 OF 5
AD
A040 320



OF 5

040320

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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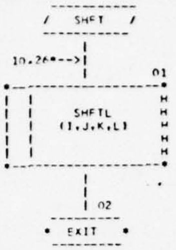
CHART TITLE - SUBROUTINE SHFT(I,J,K)



Flow Chart A-26 Preprocessor Logical Shift Caller

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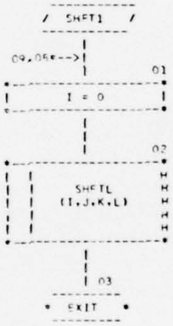
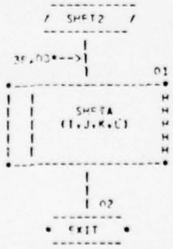
CHART TITLE - SUBROUTINE SHFT1(I,J,K)



Flow Chart A-27 Preprocessor Clear and Logical Shift Caller

09/28/76 AUTOFLOW CHART SET - LORAN 1 GROUP PHASE PREPROCESSOR PAGE 59

CHART TITLE - SUBROUTINE SHFT2(I,J,K)



Flow Chart A-28 Preprocessor Arithmetic Shift Caller

```
09/27/76         INPUT LISTING                               AUTOFLOW CHART SET - LORAN 2  GROUP PHASE EDITOR

FORTRAN MODULE      (LIST,NAMSQ)

 CARD NO        ****                        CONTENTS                                  ****

                 IMPLICIT REAL*8 (A-C,E-H,O-Z)
                 DIMENSION XY(16),XYSD(16),XYN(16),DAT(800),DATA(16,50),IHD(40),
                1SUM(4,16)
                 DIMENSION EDNOM(16)
                 DIMENSION SUM1(16)
                 DIMENSION OUT(7,100)
                 EQUIVALENCE (DATA(1,1),DAT(1))
                 COMMON SUM,IHD
                 KNT=14
                 ICD=5
                 IPT=6
                 IRD=20
                 IWT=21
               3 READ(ICD,1000)THRESH
                 IF(THRESH.EQ.0) GO TO 810
                 READ(ICD,1007)EDNOM
                 KTT=0
                 NP=0
                 NA=0
                 LCNT=0
                 ISC=0
                 READ(IHD)IHD
                 CALL PRNTHD
                 WRITE(IPT,1008)THRESH
                 WRITE(IPT,1009)EDNOM
                 CALL CLEAR(4,16)
                 DO 4 I=1,16
               4 SUM1(I)=0.D0
               1 WRITE(IPT,1001)
               2 READ(IRD,END=800,ERR=900)TD,XY,XYSD,XYN,(DAT(I),I=1,800)
                 CALL CLEAR(2,16)
                 ICNT=0
                 DO 11 I=1,50
                 CALL EDIT(DATA,EDNOM,THRESH,I,IFLG)
                 IF(IFLG.EQ.1) GO TO 11
                 ICNT=ICNT+1
                 ISC=ISC+1
                 DO 10 J=1,16
                 TEMP=DATA(J,I)
                 SUM(1,J)=SUM(1,J)+TEMP
                 SUM1(J)=SUM1(J)+TEMP
                 SUM(2,J)=SUM(2,J)+TEMP**2
              10 CONTINUE
              11 CONTINUE
                 NE=XYN(1)-ICNT+.1
                 IF(ICNT.EQ.0) GO TO 21
                 NA=NA+1
                 NP=NP+ICNT
                 DO 20 I=1,16
                 SUM(1,I)=SUM(1,I)/ICNT
                 SUM(2,I)=SUM(2,I)/ICNT
                 SUM(2,I)=DSQRT(SUM(2,I)-SUM(1,I)**2)
                 SUM(3,I)=SUM(3,I)+SUM(1,I)
                 SUM(4,I)=SUM(4,I)+SUM(1,I)**2
              20 CONTINUE
              21 WRITE(IPT,1002)TD,ICNT,NE
                 WRITE(IPT,1003)(SUM(1,I),I=1,16)
                 WRITE(IPT,1004)(SUM(2,I),I=1,16)
                 LCNT=LCNT+1
                 IF(MOD(LCNT,KNT).NE.0) GO TO 24
                 IF(ISC.EQ.0) GO TO 24
                 DO 22 I=1,16
              22 SUM1(I)=SUM1(I)/ISC
                 WRITE(IPT,1010)KNT,(SUM1(I),I=3,16)
                 KTT=KTT+1
                 CALL GPM(SUM1,OUT,KTT)
                 ISC=0
                 DO 23 I=1,16
              23 SUM1(I)=0.
           C  24 WRITE(IWT)TD,ICNT,(SUM(1,J),J=1,16),(SUM(2,K),K=1,16),
           C    1(DAT(L),L=1,800)
              24 IF(MOD(LCNT,KNT).EQ.0) GO TO 1
                 GO TO 2
             800 IF(NA.EQ.0) GO TO 3
                 DO 801 I=1,16
                 SUM(3,I)=SUM(3,I)/NA
                 SUM(4,I)=SUM(4,I)/NA
                 SUM(4,I)=DSQRT(SUM(4,I)-SUM(3,I)**2)
             801 CONTINUE
                 WRITE(IPT,1005)NP,NA
                 WRITE(IPT,1003)(SUM(3,I),I=1,16)
                 WRITE(IPT,1004)(SUM(4,I),I=1,16)
                 ADD=0.
                 DO 25 I=1,16
             802 ADD=ADD+SUM(4,I)
              25 SUM1(I)=SUM(3,I)
                 ADD=ADD/8
                 WRITE(7,1015)ADD
                 WRITE(7,1015)(SUM(3,I),I=1,16)
                 KTT=KTT+1
                 CALL GPM(SUM1,OUT,KTT)
                 WRITE(IPT,1013)
                 WRITE(IPT,1011)(I,I=10,16,2),(J,J=12,16,2)
                 DO 26 I=1,KTT
                 IF(I.NE.KTT) GO TO 26
                 WRITE(IPT,1014)
              26 WRITE(IPT,1012)(OUT(J,I),J=1,7)
           C     ENDFILE IWT
                 GO TO 3
             810 REWIND IRD
           C     REWIND IWT
                 STOP
             900 WRITE(IPT,1006)TD
                 GO TO 2
            1000 FORMAT(5F10.0)
            1001 FORMAT(1H1,16(2X,'AVG.',2X),/,1X,16(3X,'S.DEV'),/)
            1002 FORMAT(' BLOCK TIME = ' ,F12.7,
                110X,'TOTAL PULSES KEPT =',I3,
```

Program Listing A-29 Editor Driver

```
09/27/76        INPUT LISTING                    AUTOFLOW CHART SET - LORAN 2  GROUP PHASE EDITOR

CARD NO      ****                           CONTENTS                           ****

                 210X,'TOTAL PULSES EDITED =',I3)
             1003 FORMAT(1X,16F8.4)
             1004 FORMAT(2X,16F8.4,/)
             1005 FORMAT(' TOTAL NO. OF PULSES USED =',I6,
                 110X,'TOTAL NO. OF AVERAGES USED =',I5)
             1006 FORMAT(' PARITY ERROR AT TIME =',F12.7)
             1007 FORMAT(8F9.4/8F9.4)
             1008 FORMAT('0',34X,'EDITING WINDOW =',F4.2,' VOLTS')
             1009 FORMAT('0',34X,'EDITING AVERAGES USED =',/,20X,8F9.5,/,25X,8F9.5)
             1010 FORMAT(2X,I2,' BLOCK AVG. =',14F8.4)
             1011 FORMAT(4(6X,'T ',I2),3(4X,'GPM ',I2))
             1012 FORMAT(7F10.3)
             1013 FORMAT(1H1)
             1014 FORMAT(1H0)
             1015 FORMAT(8F9.4,/,8F9.4)
                  END
```

Program Listing A-29   Editor Driver (concluded)

```
FORTRAN MODULE       (LIST,NAMSQ)

CARD NO        ****                        CONTENTS                        ****

      SUBROUTINE PRNTHD
      DOUBLE PRECISION ASITE,AXMTR,AMODE,WEATH1,WEATH2,ANOTE
      DIMENSION ASITE(3,12),AXMTR(2,9),AMODE(3,8),IHD(40),IBUF(128)
      DIMENSION WIND(2)
      DIMENSION WEATH1(2,5),WEATH2(2,10)
C     DIMENSION ANOTE(2,2)
      COMMON IBUF,IHD
      DATA WIND/' LOW','HIGH'/
      DATA WEATH1/'CLEAR   ','        ','SCATTERE','D TO 50%',
     1'BROKEN T','O 90%   ','OVERCAST',' TO 100%','OBSCURAT','ION 100%'/
      DATA WEATH2/'THUNDERS','TORMS   ','RAIN SHO','WERS    ',
     1'DRIZZLE ','        ','FREEZING',' DRIZZLE','SNOW    ','        ',
     2'HAIL    ','        ','GROUND F','OG      ','FOG COVE','R       ',
     3'SUNNY   ','        ','HAZE    ','        '/
C     DATA ANOTE/'SEE LOG*','********','NO PROBL','EMS*****'/
      DATA ASITE/'NAVAL OB','SERVATOR','Y, D.C. ','CAROLINA',' BEACH O',
     1'NE      ','CAROLINA',' BEACH T','WO      ','CAROLINA',' BEACH T',
     2'HREE    ','CAROLINA',' BEACH F','OUR     ','DANA ONE','        ',
     3'        ','DANA TWO','        ','        ','DANA THR','EE      ',
     4'        ','NANTUCKE','T ONE   ','        ','NANTUCKE','T TWO   ',
     5'        ','NANTUCKE','T THREE ','        ','APL/JHU ','        ',
     6'        '/
      DATA AXMTR/'CAROLINA',' BEACH  ','JUPITER ','INLET   ','CAPE RAC',
     1'E       ','NANTUCKE','T       ','DANA    ','        ','CAPE MAY',
     2'        ','LORAN SI','MULATER ','100 KM C','ESIUM   ','SPECIAL ',
     3'TEST    '/
      DATA AMODE/'PRIMARY ','DATA    ','        ','SKYWAVE ','STUDY   ',
     1'        ','CALIBRAT','ION RUN ','        ','LAB EQUI','PMENT TE',
     2'ST      ','VAN EQUI','PMENT TE','ST      ','ANCILLAR','Y DATA  ',
     3'        ','SKYWAVE ','DIURNAL ','        ','SKYWAVE ','DETACHED',
     4'        '/
      IWT=21
      IPT=6
      WRITE(IPT,1011)
      IY=70+IHD(2)
      WRITE(IPT,1000)IHD(23),IHD(22),IY
      IY=1970+IHD(2)
      WRITE(IPT,1001)IHD(1),IY
      J=IHD(4)+1
      WRITE(IPT,1002)(ASITE(I,J),I=1,3)
      J=IHD(3)+1
      WRITE(IPT,1003)(AXMTR(I,J),I=1,2)
      J=IHD(5)+1
      WRITE(IPT,1004)(AMODE(I,J),I=1,3)
      WRITE(IPT,1012)IHD(9)
      HD=IHD(6)*.03386
      WRITE(IPT,1005)HD
      WRITE(IPT,1006)
      HD=IHD(7)/10.
      WRITE(IPT,1007)HD
      HD=IHD(8)/10.
      WRITE(IPT,1008)HD
      WRITE(IPT,1009)
      HD=IHD(10)/10.
      WRITE(IPT,1008)HD
      WRITE(IPT,1010)IHD(11)
      WRITE(IPT,1013)IHD(12),IHD(13),IHD(14)
      M=1
      K=IHD(15)/10
      IF(K.GT.4) M=2
      K=MOD(K,5)+1
      L=MOD(IHD(15),10)+1
      WRITE(IPT,1018)
      WRITE(IPT,1014)(WEATH1(N,K),N=1,2)
      WRITE(IPT,1017)(WEATH2(N,L),N=1,2)
      WRITE(IPT,1015)WIND(M)
      WRITE(IPT,1019)IHD(17)
C     WRITE(IPT,1016)(ANOTE(N,IHD(16)+1),N=1,2)
C
C
C     WRITE(IWT)IHD
C
C
    1 RETURN
 1000 FORMAT(35X,'GROUP/PHASE TEST PREPROCESSING',2X,I2,2('/',I2))
 1001 FORMAT('0',34X,'JULIAN DAY NO.',I4,9X,'YEAR NO.',I5)
 1002 FORMAT('0',34X,'DATA RECORDED AT:',3X,3A8)
 1003 FORMAT('0',34X,'TRANSMITTER LOCATED AT:',3X,2A8)
 1004 FORMAT('0',34X,'DATA RECORDING MODE:',3X,3A8)
 1005 FORMAT('0',34X,'ATMOSPHERIC PRESSURE:'F7.1,' MILLIBARS')
 1006 FORMAT('0',34X,'EXTERNAL TEMPERATURE (DEGREES CENTIGRADE)')
 1007 FORMAT(45X,'WET BULB',F5.1)
 1008 FORMAT(45X,'DRY BULB',F5.1)
 1009 FORMAT('0',34X,'INTERNAL TEMPERATURE (DEGREES CENTIGRADE)')
 1010 FORMAT('0',34X,'PRED. TIME CALIB:',I11,'.0E-09 SECONDS')
C1011 FORMAT('1',/////)
 1011 FORMAT('1',////)
 1012 FORMAT('0',34X,'ATTENUATION IN DB:'I3)
 1013 FORMAT('0',34X,'START TIME:',I4,':',I2,':',I2)
 1014 FORMAT(45X,'CLOUD COVER: ',2A8)
 1015 FORMAT(45X,A4,' GROUND WINDS')
C1016 FORMAT(////,35X,'************',2A8,'************')
 1017 FORMAT(45X,'GENERAL CONDITION: ',2A8)
 1018 FORMAT('0',34X,'WEATHER:')
 1019 FORMAT('0',34X,'GROUP REPETITION INTERVAL:',I4,'.0E-04')
      END
```

Program Listing A-30 Editor Header Page Printer

```
09/27/76         INPUT LISTING                    AUTOFLOW CHART SET - LORAN 2  GROUP PHASE EDITOR

FORTRAN MODULE        (LIST,NAMSQ)

 CARD NO          ****                                  CONTENTS                              ****

                            SUBROUTINE EDIT(DATA,XY,TH,I,IFLG)
                            IMPLICIT REAL*8 (A-C,E-H,O-Z)
                            DIMENSION XY(16),DATA(16,50)
                            IFLG=0
                            DO 1 J=1,16
                            IF(DABS(DATA(J,I)-XY(J)).GT.TH) GO TO 2
                          1 CONTINUE
                            RETURN
                          2 IFLG=1
                            DO 3 J=1,16
                          3 DATA(J,I)=9999.
                            RETURN
                            END
```

Program Listing A-31   Second-Stage Editor

```
09/27/76         INPUT LISTING                    AUTOFLOW CHART SET - LORAN 2  GROUP PHASE EDITOR

FORTRAN MODULE        (LIST,NAMSQ)

 CARD NO          ****         -                        CONTENTS                              ****

                            SUBROUTINE CLEAR(I,J)
                            IMPLICIT REAL*8(A-H,O-Z)
                            DIMENSION A(4,16)
                            COMMON A
                            DO 1 II=1,I
                            DO 1 JJ=1,J
                          1 A(II,JJ)=0.D0
                            RETURN
                            END
```

Program Listing A-32   Editor Array Reset

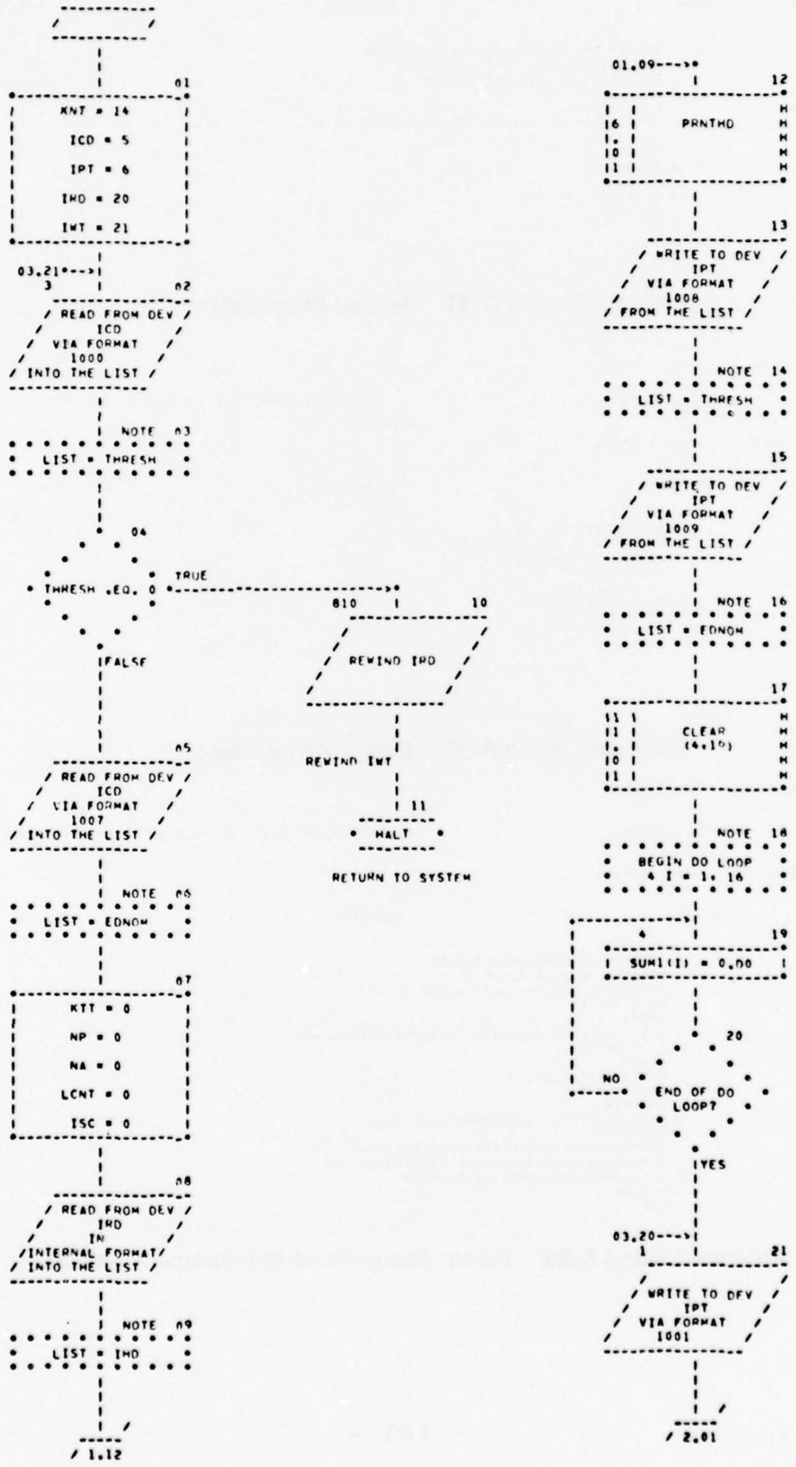
```
09/27/76         INPUT LISTING                    AUTOFLOW CHART SET - LORAN 2  GROUP PHASE EDITOR

FORTRAN MODULE        (LIST,NAMSQ)

 CARD NO          ****                                  CONTENTS                              ****

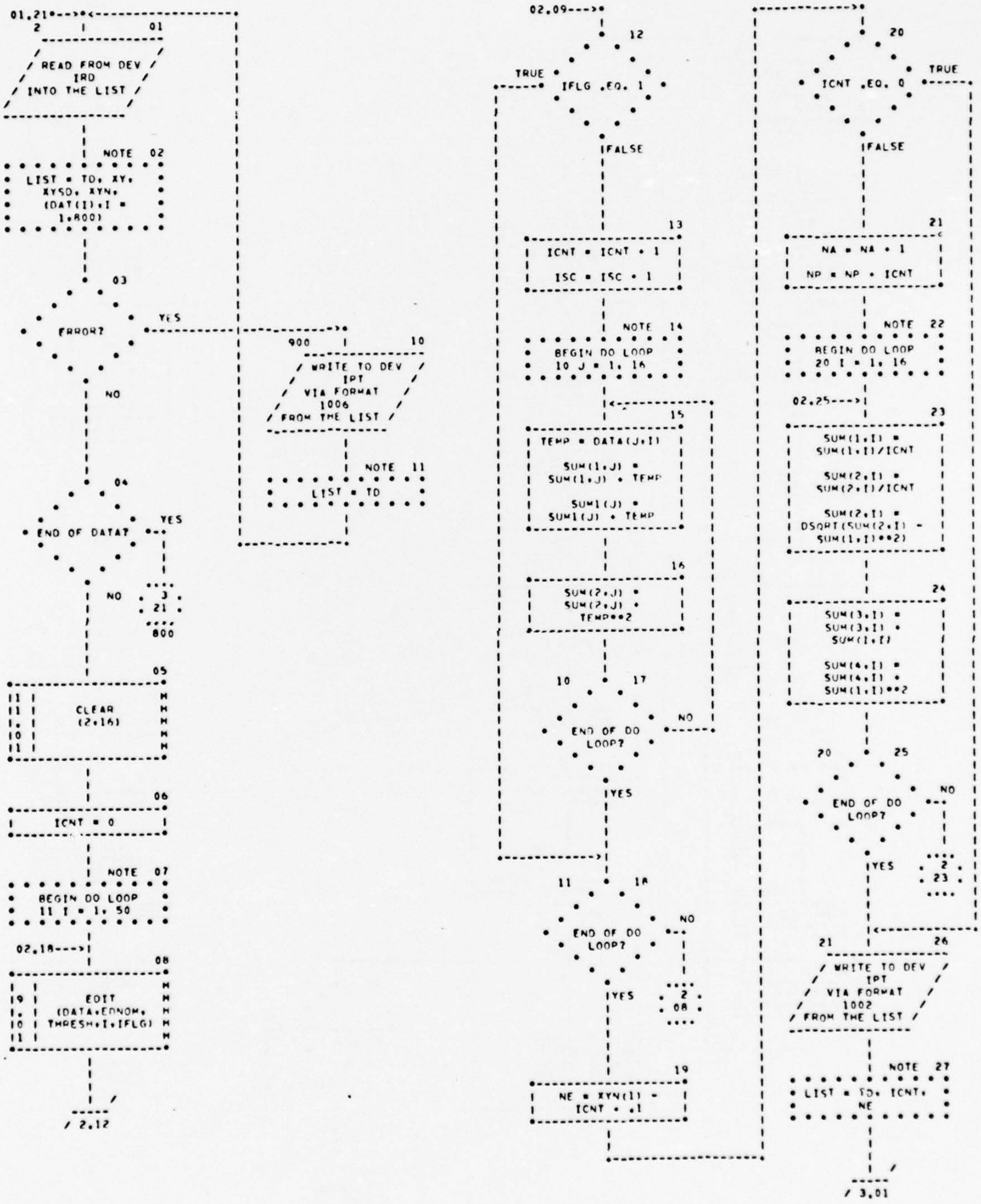
                            SUBROUTINE GPM(SUM,OUT,KNT)
                            IMPLICIT REAL*8(A-H,O-Z)
                            DIMENSION SUM(16),OUT(7,100)
                            DO 1 I=1,4
                            J=2*(I+4)
                          1 OUT(I,KNT)=-SUM(J-1)*3.18/(SUM(J)-SUM(J-2))
                            DO 2 I=1,3
                            J=I+4
                            OUT(J,KNT)=0.D00
                            DO 3 K=1,5
                            L=2*(I+K)
                          3 OUT(J,KNT)=OUT(J,KNT)+DABS(SUM(L))
                            K=2*(I+1)
                            TEMP=2*(DABS(SUM(K+8))-DABS(SUM(K)))
                            TEMP=TEMP+DABS(SUM(K+6))-DABS(SUM(K+2))
                          2 OUT(J,KNT)=10.*OUT(J,KNT)/TEMP
                            RETURN
                            END
```

Program Listing A-33   Editor Group Phase Measurement Calculator



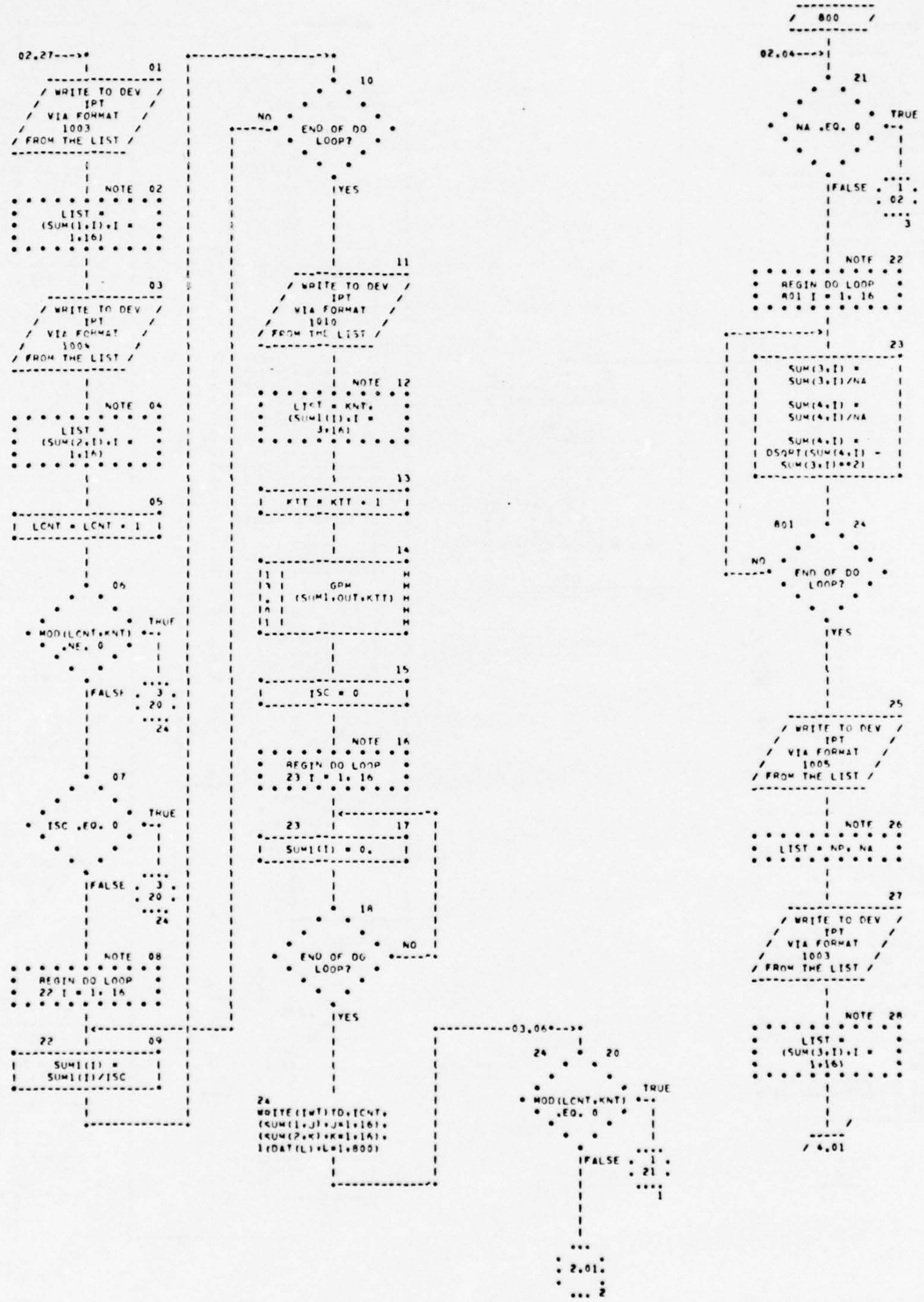
Flow Chart A-29 Editor Driver

CHART TITLE - PROCEDURES



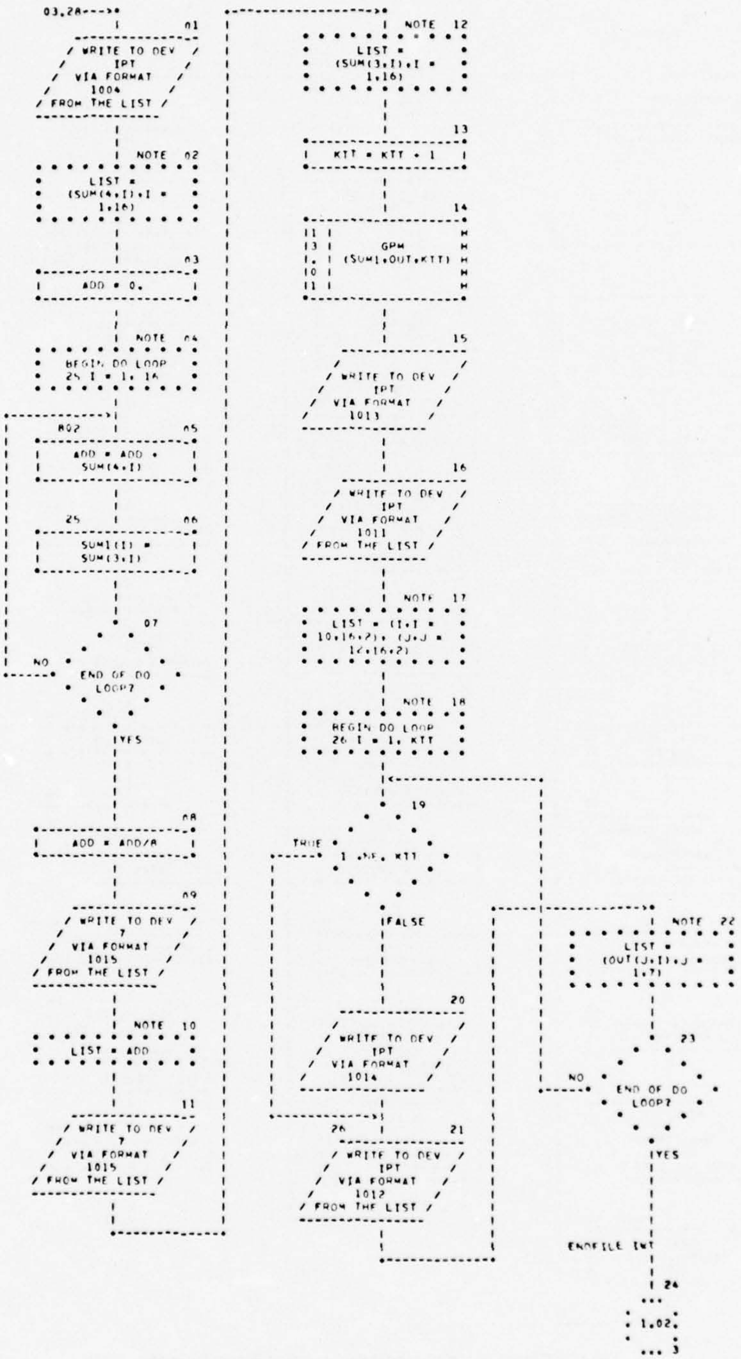
Flow Chart A-29 Editor Driver (continued)

CHART TITLE - PROCEDURES



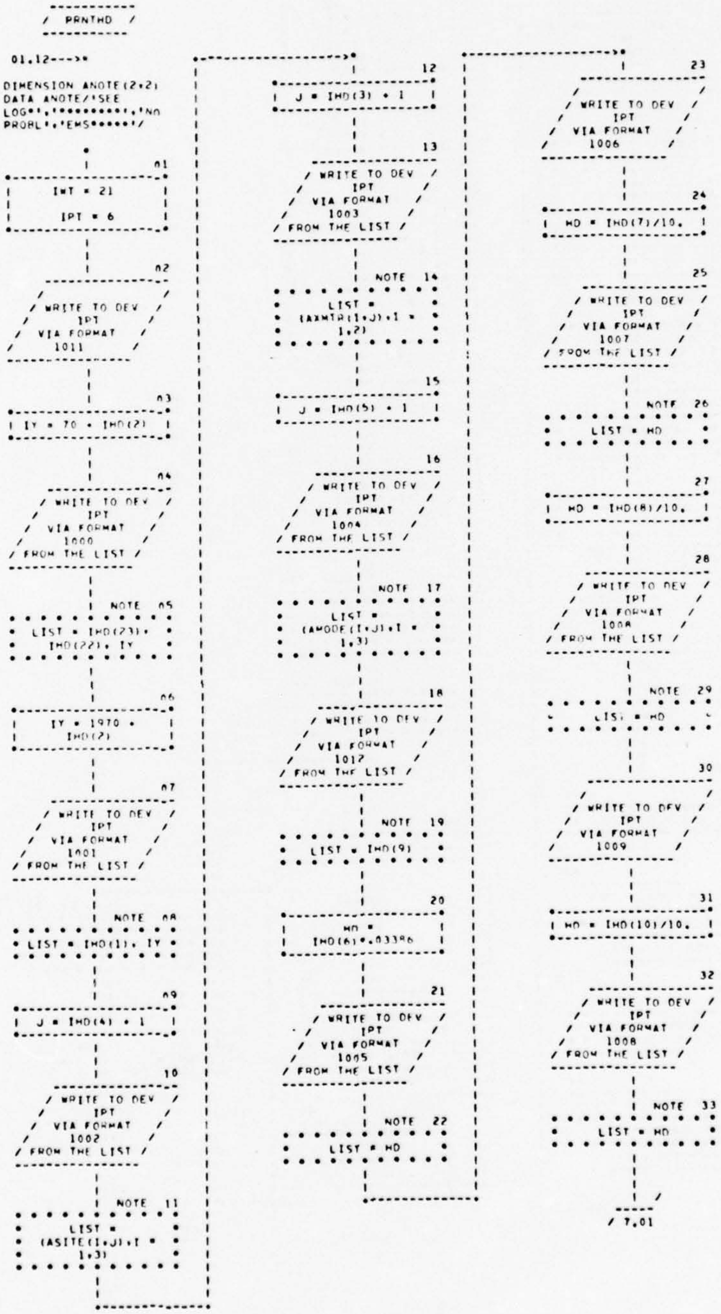
02.27--->
01
WRITE TO DEV IPT VIA FORMAT 1003 FROM THE LIST
NOTE 02
LIST = (SUM(1,I),I = 1,16)
03
WRITE TO DEV IPT VIA FORMAT 1004 FROM THE LIST
NOTE 04
LIST = (SUM(2,I),I = 1,16)
05
LCNT = LCNT + 1
06
MOD(LCNT,KNT) .NE. 0
TRUE
FALSE
3 20 24
07
ISC .EQ. 0
TRUE
FALSE
3 20 24
NOTE 08
BEGIN DO LOOP 22 I = 1, 16
22
09
SUM1(I) = SUM1(I)/ISC
10
END OF DO LOOP?
NO
YES
11
WRITE TO DEV IPT VIA FORMAT 1010 FROM THE LIST
NOTE 12
LIST = KNT, (SUM1(I),I = 3,16)
13
KTT = KTT + 1
14
GPH (SUM1,OUT,KTT)
15
ISC = 0
NOTE 16
BEGIN DO LOOP 23 I = 1, 16
23
17
SUM1(I) = 0.
18
END OF DO LOOP?
NO
YES
24
WRITE(IWT)TD,ICNT, (SUM(1,J),J=1,16), (SUM(2,K),K=1,16), (DAT(L),L=1,800)
03.06--->
24
20
MOD(LCNT,KNT) .EQ. 0
TRUE
FALSE
1 21 1
2.01 2
800
02.04--->
21
NA .EQ. 0
TRUE
FALSE
1 02 3
NOTE 22
BEGIN DO LOOP 801 I = 1, 16
23
SUM(3,I) = SUM(3,I)/NA
SUM(4,I) = SUM(4,I)/NA
SUM(4,I) = DSQRT(SUM(4,I) - SUM(3,I)**2)
801
24
END OF DO LOOP?
NO
YES
25
WRITE TO DEV IPT VIA FORMAT 1005 FROM THE LIST
NOTE 26
LIST = NP, NA
27
WRITE TO DEV IPT VIA FORMAT 1003 FROM THE LIST
NOTE 28
LIST = (SUM(3,I),I = 1,16)
4.01

Flow Chart A-29 Editor Driver (continued)


03,28
01
WRITE TO DEV IPT VIA FORMAT 1004 FROM THE LIST
NOTE 02
LIST = (SUM(4,I),I = 1,16)
03
ADD = 0.
NOTE 04
BEGIN DO LOOP 25 I = 1, 16
R02
05
ADD = ADD + SUM(4,I)
25
06
SUM1(I) = SUM(3,I)
07
NO
END OF DO LOOP?
YES
08
ADD = ADD/8
09
WRITE TO DEV 7 VIA FORMAT 1015 FROM THE LIST
NOTE 10
LIST = ADD
11
WRITE TO DEV 7 VIA FORMAT 1015 FROM THE LIST
NOTE 12
LIST = (SUM(3,I),I = 1,16)
13
KTT = KTT + 1
14
I1
I3
I.
I0
I1
GPM (SUM1,OUT,KTT)
15
WRITE TO DEV IPT VIA FORMAT 1013
16
WRITE TO DEV IPT VIA FORMAT 1011 FROM THE LIST
NOTE 17
LIST = (I,I = 10,16,2), (J,J = 12,16,2)
NOTE 18
BEGIN DO LOOP 26 I = 1, KTT
19
TRUE
I .NE. KTT
FALSE
20
WRITE TO DEV IPT VIA FORMAT 1014
26
21
WRITE TO DEV IPT VIA FORMAT 1012 FROM THE LIST
NOTE 22
LIST = (OUT(J,I),J = 1,7)
23
NO
END OF DO LOOP?
YES
ENDFILE INT
24
1.02.
3

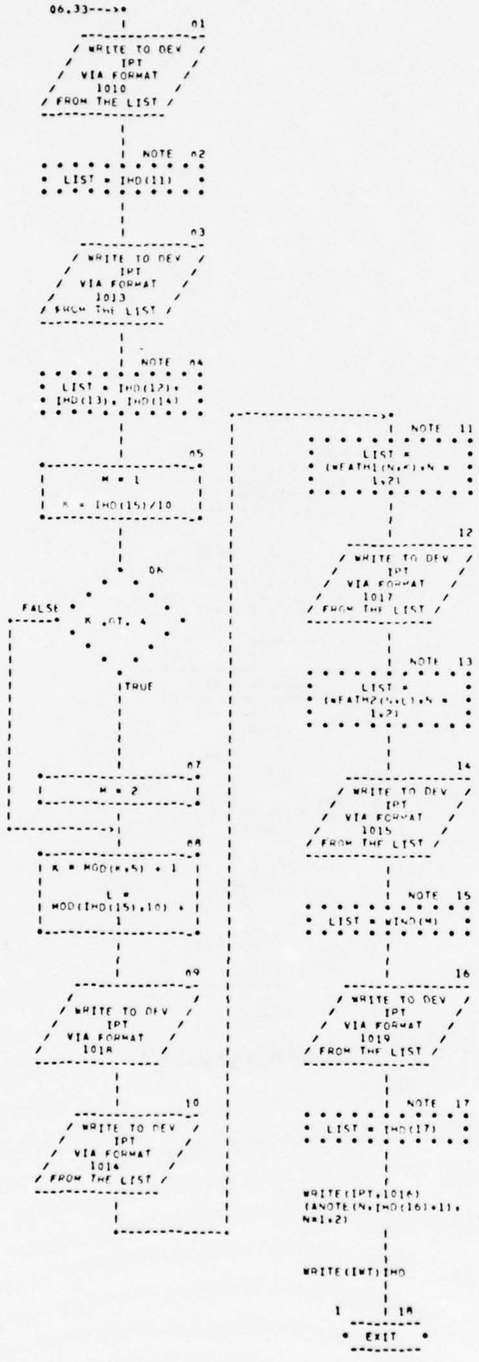
Flow Chart A-29 Editor Driver (concluded)

CHART TITLE - SUBROUTINE PRNTHD



Flow Chart A-30 Editor Header Page Printer

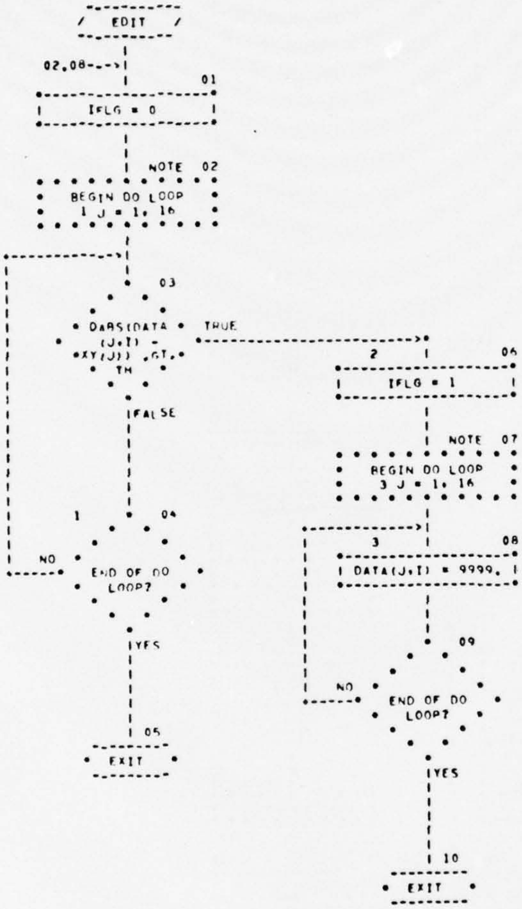
CHART TITLE - SUBROUTINE PRNTHD


06.33--->
01
WRITE TO DEV IPT VIA FORMAT 1010 FROM THE LIST
NOTE 02
LIST = IHD(11)
03
WRITE TO DEV IPT VIA FORMAT 1013 FROM THE LIST
NOTE 04
LIST = IHD(12), IHD(13), IHD(14)
05
M = 1
K = IHD(15)/10
06
K .GT. 4
FALSE
TRUE
07
M = 2
08
K = MOD(K,5) + 1
L = MOD(IHD(15),10) + 1
09
WRITE TO DEV IPT VIA FORMAT 1018
10
WRITE TO DEV IPT VIA FORMAT 1014 FROM THE LIST
NOTE 11
LIST = (WEATH1(N,K),N = 1,2)
12
WRITE TO DEV IPT VIA FORMAT 1017 FROM THE LIST
NOTE 13
LIST = (WEATH2(N,L),N = 1,2)
14
WRITE TO DEV IPT VIA FORMAT 1015 FROM THE LIST
NOTE 15
LIST = WIND(M)
16
WRITE TO DEV IPT VIA FORMAT 1019 FROM THE LIST
NOTE 17
LIST = IHD(17)
WRITE(IPT,1016)
(ANOTE(N,IHD(16)+1),
N=1,2)
WRITE(IWT)IHD
1
18
EXIT

```
1011
FORMAT('1',//////)
1016
FORMAT(/////,35X,
'**************',2A8,
'**************')
```

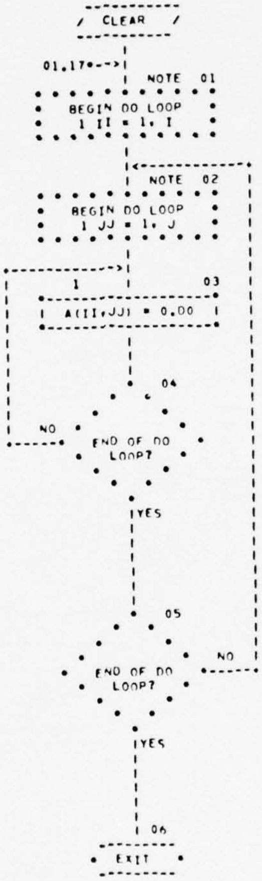
Flow Chart A-30 Editor Header Page Printer (concluded)

CHART TITLE - SUBROUTINE EDIT(DATA,XY,TH,I,IFLG)



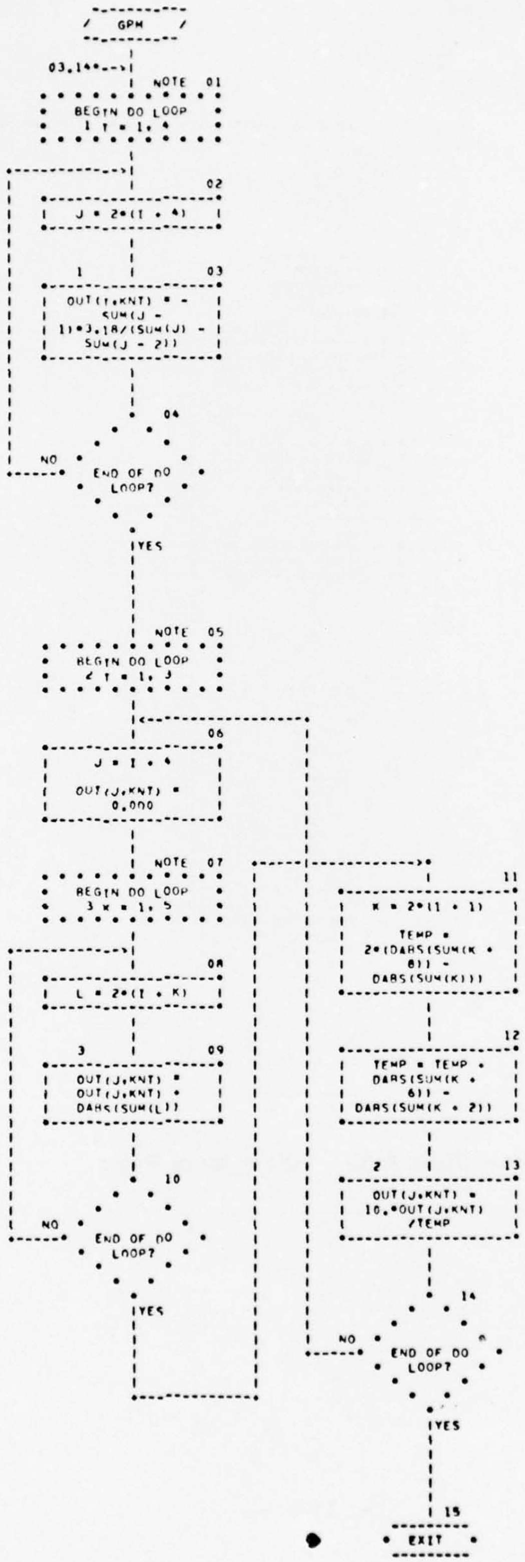
Flow Chart A-31 Second-Stage Editor

CHART TITLE - SUBROUTINE CLEAR(I,J)



Flow Chart A-32 Editor Array Reset

CHART TITLE - SUBROUTINE GPM(SUM,OUT,KNT)



Flow Chart A-33 Editor Group Phase Measurement Calculator

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

 CARD NO        ****                              CONTENTS                              ****

                      IMPLICIT REAL*8(A-C,E-H,O-Z)
                      DIMENSION B(256,2),AVGPWR(2)
                      DIMENSION JCHK(5),IHD(40),IBUF(128)
                      DIMENSION GRDTOT(3,32),ARR(8194,2)
                      DIMENSION DQI(8192)
                      COMMON IHD,GRDTOT,ARR,DQI,B
                      COMMON/GETDAT/IRT,IBUF
                      COMMON/CARD/TTA,SDTOA,SN,FS
                      COMMON/PRINT/IPT
                      IPT=6
                      IRC=0
                      IFLG=0
                      TP=62.5
                      PHI=0.0
                      ECD=0.0
                    1 CALL CRDIN(JCHK,AEF)
                      IF(JCHK(1).EQ.999) GO TO 4
                      CALL INIT
                      ITRY=0
                    2 CALL RDHD
                      CALL CODF(ITRY)
                      IF(ITRY.EQ.0) GO TO 8
                      IF(ITRY.LE.7) GO TO 2
                      ENDFILE 21
                      CALL SKIPFL
                      GO TO 1
                    8 CALL PRNTTL(IHD,IPT)
                      CALL PRNTHD
                      CALL MAINE
                      CALL CONF(TADJ)
                      CALL STAT1
                    5 CALL HIST
                      CALL PLOT
                      IF(JCHK(2).EQ.0) GO TO 3
                      IF(JCHK(3).EQ.0) GO TO 6
                      CALL TOA
                      CALL AMP
                    6 CALL DFFTA(ARR,IHD(25),0)
                      CALL DFFTA(ARR(1,2),IHD(25),0)
                      CALL PLOT1(AVGPWR)
                      IF(JCHK(3).EQ.0) GO TO 7
                      CALL EDITF(AVGPWR)
                      CALL PLOT1(AVGPWR)
                    7 CALL DFFTA(ARR,IHD(25),2)
                      CALL DFFTA(ARR(1,2),IHD(25),2)
                      IF(JCHK(3).EQ.0) GO TO 3
                      CALL HIST
                      CALL MVAMP
                    3 CALL PRNTTL(IHD,IPT)
                      CALL PRNTHD
                      CALL SNFS(JCHK,AEF,1)
                      CALL TOA
                      CALL AMP
                      IF(JCHK(3).NE.0) GO TO 1
                      CALL SNFS(JCHK,AEF,2)
                      WRITE(7,1000)IHD(1),TTA,SDTOA,SN,FS
                      WRITE(7,1002)TP,PHI,ECD,TADJ
                      GO TO 1
                    4 REWIND 21
                      WRITE(7,1001)
                      STOP
                 1000 FORMAT(I6,4D16.8)
                 1001 FORMAT(3X,'999')
                 1002 FORMAT(4F15.5)
                      END
```

Program Listing A-34   Frequency Filter Driver

```
09/28/76          INPUT LISTING                              AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO          ****                               CONTENTS                                   ****

     1                       SUBROUTINE CRDIN(JCHK,AEF)
     2                       IMPLICIT REAL*8(A-C,E-H,O-Z)
     3                       DIMENSION JCHK(5),IBUF(128),IHD(40)
     4                       COMMON IHD
     5                       COMMON/GETDAT/IRT,IBUF
     6                       COMMON/PRINT/IPT
     7             C         1 = POWER OF TWO (999 STOP)
     8             C         2 = FOURIER (1=YES,0=N))
     9             C         3 = FILTER LEVEL(NOT EQ ZERO-AMP CALC AT T12)
    10             C         4 = T READING FOR AMPLITUDE CALCULATION
    11             C         IHD(29) = PROCESS DAY NUMBER
    12             C         AEF = ANT EFFECTIVE HEIGHT
    13                       IRD=5
    14                     3 READ(IRD,1000)(JCHK(I),I=1,5),IHD(29),AEF
    15                       IF(JCHK(1).EQ.0) JCHK(1)=12
    16                       IF(JCHK(4).EQ.0) JCHK(4)=91
    17                       IF(JCHK(5).EQ.0) JCHK(5)=18
    18                       IF(AEF.EQ.0) AEF=.007
    19                       IHD(26)=JCHK(5)
    20                       IHD(27)=JCHK(3)
    21                       IHD(28)=2**JCHK(1)
    22                       IF(JCHK(3).NE.0) IHD(26)=12
    23                     1 RETURN
    24                  1000 FORMAT(6I6,F6.2)
    25                       END
```

Program Listing A-35   Frequency Filter Card Input

```
09/28/76          INPUT LISTING                              AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO          ****                               CONTENTS                                   ****

     1                       SUBROUTINE INIT
     2                       IMPLICIT REAL*8(A-H,O-Z)
     3                       DIMENSION IHD(40),GRDTOT(3,32)
     4                       COMMON IHD,GRDTOT
     5                       IHD(25)=0
     6             C         IHD(35)=PULSE COUNT
     7                       IHD(35)=0
     8                       CALL CLEAR(GRDTOT,192)
     9             C         IHD(37) IS TOTAL NO. OF REJECTED PULSES
    10                       IHD(37)=0
    11             C         IHD(38) IS TOTAL NO OF MISSING RECORDS
    12                       IHD(38)=0
    13                       RETURN
    14                       END
```

Program Listing A-36   Frequency Filter Initializer

```
FORTRAN MODULE      (LIST,NAMSQ)

 CARD NO      ****                    CONTENTS                    ****

      SUBROUTINE RDHD
      DIMENSION IBUF(128),IHD(40)
      DOUBLE PRECISION GRDTOT(3,32)
      COMMON IHD,GRDTOT
      COMMON/GETDAT/IRT,IBUF
      COMMON/PRINT/IPT
C     1=JULIAN DAY
C     2=YEAR-1970
C     3=XMTR NO.
C     4=SITE NO.
C     5=DATA MODE
C     6=ATMOS PRESS
C     7=OUTSIDE WET BULB
C     8=OUTSIDE DRY BULB
C     9=ATTENUATION
C     10=INSIDE DRY BULB
C     11=OBJECT OF RUN
C     12=HOURS START TIME
C     13=MINUTES START TIME
C     14=SECONDS START TIME
C     15=WEATHER CODE
C     16=NOTE CODE
C     17=GRI
C     18=START TIME IN SECONDS AFTER MIDNIGHT
C     19=MODE OF RUN
C     20=MISSION OF RUN
C     21=RUN NUMBER
C     22=DAY NUMBER
C     23=MONTH NUMBER
C     25=FFT POINT FLAG(SUB XY)
C     26=AMP CALC ON 3RD CYCLE OR PEAK OF PULSE---SET IN CRDIN
C     27=FILTER LEVEL MULTIPLIER USED IN EDITF-----SET IN CRDIN
C     28=POWER OF 2 FOR NO. OF POINTS TO PROCESS
C     29=PROCESSING DAY NUMBER
C     30=PULSE NUMBER
C     31=PULSE CODE TABLE START
C     35=PULSE COUNT
C     39=MISSING RECORD COUNT
C     40=BAD PULSE PER BLOCK COUNT
C     SKIP FIRST RECORD
    2 CALL GETREC
      GO TO(3,2,12,900),IRT
    3 CALL GETREC
      GO TO(4,3,10,11),IRT
C     TIME TO EVEN SECOND
    4 CALL BCDTB(113,1,2,IBUF,128,IHD(12))
      CALL BCDTB(113,3,2,IBUF,128,IHD(13))
      CALL BCDTB(113,5,2,IBUF,128,IHD(14))
C     ATTENUATION
    6 CALL BCDTB(114,8,2,IBUF,128,IHD(9))
C     OBJECT
      CALL BCDTB(115,3,2,IBUF,128,IHD(11))
C     MODE
      CALL BCDTB(115,5,2,IBUF,128,IHD(19))
C     MISSION
      CALL BCDTB(115,7,2,IBUF,128,IHD(20))
C     RUN NUMBER
      CALL BCDTB(116,1,1,IBUF,128,IHD(21))
C     PULSE NUMBER
      CALL BCDTB(116,2,2,IBUF,128,IHD(30))
C     JULIAN DAY AND YEAR
      CALL BCDTB(116,4,3,IBUF,128,IHD(1))
      IF(IHD(29).EQ.0) IHD(29)=IHD(1)
      CALL BCDTB(116,7,1,IBUF,128,IHD(2))
C     XMTR CODE
      CALL BCDTB(116,8,1,IBUF,128,IHD(3))
C     MODE
      CALL BCDTB(117,1,1,IBUF,128,IHD(5))
C     SITE CODE
      CALL BCDTB(117,2,2,IBUF,128,IHD(4))
C     WEATHER CODE
      CALL BCDTB(117,4,2,IBUF,128,IHD(15))
C     NOTE CODE
      CALL BCDTB(117,6,1,IBUF,128,IHD(16))
C     INSIDE TEMP
      CALL BCDTB(117,7,3,IBUF,128,IHD(10))
C     OUTSIDE TEMP(WET,DRY)
      CALL BCDTB(118,2,3,IBUF,128,IHD(7))
      CALL BCDTB(118,5,3,IBUF,128,IHD(8))
C     PRESSURE
      CALL BCDTB(118,8,5,IBUF,128,IHD(6))
C     GRI
      CALL BCDTB(119,5,5,IBUF,128,IHD(17))
C
C
C
      IHD(18)=IHD(12)*3600+IHD(13)*60+IHD(14)
      RETURN
   10 WRITE(IPT,1000)
      GO TO 3
   11 WRITE(IPT,1001)
      STOP
   12 WRITE(IPT,1002)
      GO TO 2
  900 WRITE(IPT,2000)
      STOP
 1000 FORMAT(' EOF ENCOUNTERED, TRY AGAIN',///)
 1001 FORMAT(' NO DD CARD THIS FILE')
 1002 FORMAT(' EOF FIRST REC SKIP')
 2000 FORMAT(' NO DD CARD FOR FIRST FILE SKIP')
      END
```

Program Listing A-37 Frequency Filter Header Information Decommutator

```
09/28/76          INPUT LISTING                         AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

 CARD NO        ****                              CONTENTS                               ****

                     SUBROUTINE CODE(ITRY)
                     DIMENSION IHD(40),ITAB(7,4),NTAB(7)
                     DATA ITAB/1,1,1,1,1,1,1,1,1,-1,-1,1,1,-1,1,-1,1,-1,1,-1,1,
                    1-1,-1,-1,-1,-1,-1,-1/
                     COMMON IHD
                     COMMON/PRINT/IPT
                   1 CALL GETTAB(NTAB)
                     DO 4 I=1,4
                     DO 4 J=1,4
                     DO 2 K=J,7
                     L=K-J+1
                     IF(NTAB(L).NE.ITAB(K,I)) GO TO 4
                   2 CONTINUE
                     DO 3 K=1,4
                     M=J+K-1
                   3 IHD(K+30)=ITAB(M,I)
                     GO TO 10
                   4 CONTINUE
                   5 WRITE(IPT,1000)
                     ITRY=ITRY+1
                     RETURN
                  10 IF(IHD(5).GT.2) GO TO 20
                     IF(MOD(IHD(30),2).EQ.0.AND.I.EQ.3) GO TO 13
                     IF(I.EQ.1.AND.IHD(30).EQ.1.OR.IHD(30).EQ.5) GO TO 13
                     IF(I.EQ.4.AND.IHD(30).EQ.3.OR.IHD(30).EQ.7) GO TO 13
                     WRITE(IPT,1002)(IHD(N),N=31,34)
                     ITRY=0
                     RETURN
                  20 IF(MOD(IHD(30),2).EQ.0.AND.I.EQ.2) GO TO 13
                     IF(I.EQ.1.AND.IHD(30).EQ.1.OR.IHD(30).EQ.9) GO TO 13
                     IF(I.EQ.4.AND.IHD(30).EQ.5.OR.IHD(30).EQ.13) GO TO 13
                     IF(I.EQ.3.AND.MOD(IHD(30),2).EQ.1) GO TO 13
                     WRITE(IPT,1002)(IHD(N),N=31,34)
                     ITRY=0
                  13 RETURN
                1000 FORMAT('1',20X,'PHASE CODE NOT IN TABLE')
                1002 FORMAT('1',20X,'INCORRECT PHASE CODE INPUT',4I4)
                     END
```

Program Listing A-38   Frequency Filter Pulse Phase Code Decoder

```
09/28/76          INPUT LISTING                         AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

 CARD NO        ****                              CONTENTS                               ****

                     SUBROUTINE GETTAB(NTAB)
                     DIMENSION NTAB(7),IHD(40),IBUF(128)
                     COMMON IHD
                     COMMON/GETDAT/IRT,IBUF
                     COMMON/PRINT/IPT
                     DO 1 I=1,7
                     J=16*(I-1)+10
                     L=IBUF(J)
                     CALL SHFTL(K,L,48,M)
                     CALL SHFTA(K,L,-16,M)
                   1 NTAB(I)=K/IABS(K)
                     RETURN
                     END
```

Program Listing A-39   Frequency Filter Phase Code Generator

```
09/28/76        INPUT LISTING                      AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

 CARD NO        ****                          CONTENTS                               ****

                    SUBROUTINE PRNTHD
                    DIMENSION AMODE(3,8),IHD(40),IBUF(128)
                    DIMENSION WIND(2)
                    DIMENSION WEATH1(2,5),WEATH2(2,10)
                    DIMENSION ANOTE(2,2)
                    DOUBLE PRECISION AMODE,WEATH1,WEATH2,ANOTE,TB
                    DATA WIND/' LOW','HIGH'/
                    DATA WEATH1/'CLEAR   ','        ','SCATTERE','D TO 50%',
                   1'BROKEN T','O 90%   ','OVERCAST',' TO 100%','OBSCURAT','ION 100%'/
                    DATA WEATH2/'THUNDERS','TORMS   ','RAIN SHO','WERS    ',
                   1'DRIZZLE ','        ','FREEZING',' DRIZZLE','SNOW    ','        ',
                   2'HAIL    ','        ','GROUND F','OG      ','FOG COVE','R       ',
                   3'SUNNY   ','        ','HAZE    ','        '/
                    DATA ANOTE/'SEE LOG*','********','NO PROBL','EMS*****'/
                    DATA AMODE/'        ','        ','        ',
                   1'LORAN C ','MASTER  ','        ',
                   2'LORAN C ','SECONDAR','Y       ',
                   3'LORAN D ','MASTER  ','        ',
                   4'LORAN D ','X OR Z S','LAVE    ',
                   5'LORAN D ','Z SLAVE ','        '/
                    COMMON IHD
                    COMMON/GETDAT/IRT,IBUF
                    COMMON/PRINT/IPT
                    IWT=21
                    WRITE(IPT,1011)
                    IY=70+IHD(2)
                    WRITE(IPT,1000)IHD(23),IHD(22),IY
                    CALL DATE(IHD(29),ID,IM)
                    WRITE(IPT,1020)IM,ID,IY
                    IY=1970+IHD(2)
                    WRITE(IPT,1001)IHD(1),IY
                    WRITE(IPT,1002) IHD(4)
                    WRITE(IPT,1003) IHD(3)
                    J=IHD(5)+1
                    WRITE(IPT,1004)(AMODE(I,J),I=1,3)
                    WRITE(IPT,1022)IHD(33)
                    WRITE(IPT,1012)IHD(9)
                    HD=IHD(6)*.03386
                    WRITE(IPT,1005)HD
                    WRITE(IPT,1006)
                    HD=IHD(7)/10.
                    WRITE(IPT,1007)HD
                    HD=IHD(8)/10.
                    WRITE(IPT,1008)HD
                    WRITE(IPT,1009)
                    HD=IHD(10)/10.
                    WRITE(IPT,1008)HD
                    WRITE(IPT,1010)IHD(11),IHD(19),IHD(20),IHD(21)
                    WRITE(IPT,1013)IHD(12),IHD(13),IHD(14)
                    M=1
                    K=IHD(15)/10
                    IF(K.GT.4) M=2
                    K=MOD(K,5)+1
                    L=MOD(IHD(15),10)+1
                    WRITE(IPT,1018)
                    WRITE(IPT,1014)(WEATH1(N,K),N=1,2)
                    WRITE(IPT,1017)(WEATH2(N,L),N=1,2)
                    WRITE(IPT,1015)WIND(M)
                    WRITE(IPT,1019)IHD(17)
                    WRITE(IPT,1016)(ANOTE(N,IHD(16)+1),N=1,2)
                    IF(IHD(35).GT.0) GO TO 1
              C
              C
                    WRITE(21)IHD
                    CALL TIME(TB)
                    WRITE(IPT,1021)TB
              C
              C
                  1 RETURN
               1000 FORMAT(45X,'LORAN SIGNAL ENVIRONMENT',2X,I2,2('/',I2))
               1001 FORMAT('0',44X,'DAY NO.',I4,9X,'YEAR NO.',I5)
               1002 FORMAT('0',44X,'DATA COLLECTION SITE CODE =',I3)
               1003 FORMAT('0',44X,'TRANSMITTER CONFIGURATION CODE =',I2)
               1004 FORMAT('0',44X,'DATA RECORDING MODE:',3X,3A8)
               1005 FORMAT('0',44X,'ATMOSPHERIC PRESSURE: 'F7.1,' MILLIBARS')
               1006 FORMAT('0',44X,'EXTERNAL TEMPERATURE (DEGREES CENTIGRADE)')
               1007 FORMAT(55X,'WET BULB',F5.1)
               1008 FORMAT(55X,'DRY BULB',F5.1)
               1009 FORMAT('0',44X,'INTERNAL TEMPERATURE (DEGREES CENTIGRADE)')
               1010 FORMAT('0',44X,'OBJECT/MODE/MISSION/RUN',4X,3(I2,'/'),I1)
               1011 FORMAT('1',//)
               1012 FORMAT('0',44X,'ATTENUATION IN DB: 'I3)
               1013 FORMAT('0',44X,'START TIME:',I4,':',I2,':',I2)
               1014 FORMAT(55X,'CLOUD COVER: ',2A8)
               1015 FORMAT(55X,A4,' GROUND WINDS')
               1016 FORMAT(//,45X,'************',2A8,'************',///)
               1017 FORMAT(55X,'GENERAL CONDITION: ',2A8)
               1018 FORMAT('0',44X,'WEATHER:')
               1019 FORMAT('0',44X,'GROUP REPETITION INTERVAL:',I4,'.0E-04')
               1020 FORMAT('0',44X,'PROCESSING DATE',2X,I2,2('/',I2))
               1021 FORMAT('0',44X,'TIME OF FIRST BLOCK IN SECS:',F10.7)
               1022 FORMAT('0',44X,'PULSE NUMBER:',I3)
                    END
```

Program Listing A-40 Frequency Filter Header Page Printer

```
09/28/76        INPUT LISTING                              AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE      (LIST,NAMSQ)

 CARD NO        ****                            CONTENTS                              ****

                SUBROUTINE MAINE
                DIMENSION IBUF(128),CAT(1600),IHD(40)
                DIMENSION GROTOT(3,32)
                DOUBLE PRECISION TB,TBP,TD,GRI
                DOUBLE PRECISION GROTOT
                COMMON IHD,GROTOT
                COMMON/GETDAT/IRT,IBUF
                COMMON/PRINT/IPT
                GRI=IHD(17)*.000100
                IPCT=0
                IERR=0
                CALL TIME(TB)
                TBP=TB
              9 CALL SET(DAT)
                IDCT=0
          C     IHD(39) IS USED TO COUNT MISSING RECORDS
                IHD(39)=0
          C     IHD(40) IS USED TO COUNT BAD PULSES IN A BLOCK
                IHD(40)=0
                TD=TBP+IPCT*GRI
             10 CALL BLOCK(DAT,IDCT,IPCT,IERR)
                IF(IDCT.LT.1600) GO TO 11
                CALL OUTPUT(TD,CAT)
                IHD(37)=IHD(37)+IHD(40)
                IHD(38)=IHD(38)+IHD(39)
                IF(IHD(25).GE.IHD(28)) GO TO 30
            101 IF(IPCT.LT.7) GO TO 9
             11 TBP=TBP+7*GRI
                IPCT=0
                IF(IERR.NE.0) GO TO 14
             12 CALL GETREC
                GO TO(13,12,17,18),IRT
          C     TEST FOR CHANGE OF RECORDING MODE
             13 CALL RCDTH(117,1,1,IBUF,128,MDSV)
                IF(IHD(5).NE.MDSV) GO TO 17
                CALL TIME(TB)
          C     TEST FOR MISSING RECORD
             14 IF((TB-TBP).GT.6*GRI) GO TO 16
          C     TEST FOR INTERMEDIATE RECORD
                IF((TBP-TB).GT..001) GO TO 12
                IERR=0
                TBP=TB
             15 IF(1600-IDCT)9,9,10
             16 IERR=1
                IHD(39)=IHD(39)+1
                WRITE(IPT,1001)TBP
                GO TO 15
             17 WRITE(IPT,1002)TD
                I=13
             23 IF(IHD(25).GE.2**I) GO TO 24
                I=I-1
                IF(I.EQ.0) RETURN
                GO TO 23
             24 IHD(25)=I
                ENDFILE 21
             20 RETURN
             30 CALL SKIPFL
                GO TO 17
             18 WRITE(IPT,1000)
                STOP
           1000 FORMAT(' NO DD CARD THIS FILE')
           1001 FORMAT(' RECORD MISSING AT TIME',F14.7)
           1002 FORMAT('0',44X,'TIME OF LAST BLOCK IN SECS:',F12.7,///)
                END
```

Program Listing A-41   Frequency Filter Main Data Handler

```
09/28/76        INPUT LISTING                    AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE      (LIST,NAMSQ)

  CARD NO        ****                           CONTENTS                               ****

                       SUBROUTINE CONF(TADJ)
                       IMPLICIT REAL*8(A-H,O-Z)
                       DIMENSION IHO(40),GROTOT(3,32),ARR(8194,2)
                       COMMON IHO,GROTOT,ARR
                       COMMON/PRINT/IPT
                       AMAX=0.0
                       DO 1 I=2,32,2
                       A=DABS(GROTOT(1,I))
                       IF(A.LE.AMAX) GO TO 1
                       AMAX=A
                       I1=I
                     1 CONTINUE
                       AMIN=9999.
                       DO 2 I=2,20,2
                       A=DABS(.5-DABS(GROTOT(1,I)/AMAX))
                       IF(A.GE.AMIN) GO TO 2
                       AMIN=A
                       I2=I
                     2 CONTINUE
                       WRITE(IPT,1000)I1
                       WRITE(IPT,1001)I2
                       TADJ=5*(I8-I1)
                       RETURN
                  1000 FORMAT(50X,'MAX VOLTAGE READING AT T',I2)
                  1001 FORMAT(//,50X,'MID VOLTAGE READING AT T',I2)
                       END
```

Program Listing A-42   Frequency Filter Lock-On Confirmation

```
09/28/76        INPUT LISTING                    AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE      (LIST,NAMSQ)

  CARD NO        ****                           CONTENTS                               ****

                       SUBROUTINE BLOCK(DAT,IDCT,IPCT,IERR)
                       DIMENSION DAT(1),IBUF(128),IHO(40)
                       COMMON IHO
                       COMMON/GETDAT/IRT,IBUF
                       COMMON/PRINT/IPT
                       IP=IPCT+1
                       DO 2 I=IP,7
                       IHO(35)=IHO(35)+1
                       N=MOD(IHO(35)+3,4)+31
                       DO 1 J=1,16
                       IDCT=IDCT+2
                       IF(IERR.NE.0) GO TO 1
                       K=16*(I-1)+J
                       CALL XY(IDCT,K,DAT,J,N)
                     1 CONTINUE
                     4 IF(IDCT.EQ.1600) GO TO 3
                     2 CONTINUE
                     3 IPCT=I
                       RETURN
                  1000 FORMAT(16F8.4)
                       END
```

Program Listing A-43   Frequency Filter Data Blocker

```
10/14/76        INPUT LISTING                    AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE      (LIST,NAMSQ)

  CARD NO        ****                           CONTENTS                               ****

                       SUBROUTINE TIME(TB)
                       DIMENSION IBUF(128),IHO(40)
                       DOUBLE PRECISION TB
                       COMMON IHO
                       COMMON/GETDAT/IRT,IBUF
                       COMMON/PRINT/IPT
                       TB=0.0D0
                       DO 1 I=1,3
                       J=I+11
                       K=I*2-1
                       CALL BCDTB(113,K,2,IBUF,128,M)
                     1 TB=(M-IHO(J))*60**(3-I)+TB
                       CALL BCDTB(113,7,7,IBUF,128,M)
                       TB=TB+M*.000000100
                       RETURN
                       END
```

Program Listing A-44   Frequency Filter Time Decoder

```
10/14/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO        ****                             CONTENTS                                   ****

                      SUBROUTINE SET(DAT)
                      DIMENSION DAT(1)
                      DO 1 I=1,1600
                    1 DAT(I)=9959.
                      RETURN
                      END
```

Program Listing A-45   Frequency Filter Array Reset

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO        ****                             CONTENTS                                   ****

                      SUBROUTINE XY(IDCT,K,DAT,L,N)
                      DIMENSION QI(8192)
                      DIMENSION DAT(1),IBUF(128),IHD(40)
                      DOUBLE PRECISION ARR(8194,2),GRDTOT(3,32)
                      DOUBLE PRECISION A
                      COMMON IHD,GRDTCT,ARR,QI
                      COMMON/GETDAT/IRT,IBUF
                      COMMON/PRINT/IPT
                      J=0
                      I=IBUF(K)
                      CALL SHFTL(J,I,32,M)
                      CALL SHFTA(J,I,-16,M)
                      DAT(IDCT-1)=J*1.2208375E-3*IHD(N)
                      J=0
                      CALL SHFTL(J,I,32,M)
                      CALL SHFTA(J,I,-16,M)
                      DAT(IDCT)=J*1.2208375E-3*IHD(N)
                      IF(IHD(25).GE.8192) GO TO 10
                      IF(MOD(IDCT,32).NE.12) GO TO 1
                      IHD(25)=IHD(25)+1
                      ARR(IHD(25),1)=DAT(IDCT-1)
                      ARR(IHD(25),2)=DAT(IDCT)
               C      IHD(26) IS SET IN CRDIN AS 3RD CYCLE OR PEAK PULSE AMP PLOT
                    1 IF(MOD(IDCT,32).NE.IHD(26)) GO TO 10
                      A=DAT(IDCT-1)**2+DAT(IDCT)**2
                      QI(IHD(25))=DSQRT(A)
                   10 CALL EDIT(IDCT,DAT,L)
                      RETURN
                      END
```

Program Listing A-46   Frequency Filter Measurement Decoder

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO        ****                             CONTENTS                                   ****

                      SUBROUTINE OUTPUT(TD,DAT)
                      DIMENSION DAT(1)
                      DIMENSION GRDTOT(3,32)
                      DIMENSION IBUF(128),IHD(40)
                      DOUBLE PRECISION TD,XY,XY2,XYSD,XYN
                      DOUBLE PRECISION GRDTOT
                      DOUBLE PRECISION TEMP
                      COMMON IHD,GRDTCT
                      COMMON/GETDAT/IRT,IBUF
                      COMMON/PRINT/IPT
                      DO 1 I=1,1600
                      IF(DAT(I).GT.9000.) GO TO 1
                      J=MOD(I,32)
                      IF(J.EQ.0) J=32
                      GRDTOT(1,J)=GRDTOT(1,J)+DAT(I)
                      GRDTOT(2,J)=GRDTOT(2,J)+DAT(I)**2
                      GRDTOT(3,J)=GRDTOT(3,J)+1
                    1 CONTINUE
                      WRITE(21) TD,(DAT(I),I=1,1600)
                    3 RETURN
                      END
```

Program Listing A-47   Frequency Filter Output Tape Writer

```
09/28/76        INPUT LISTING                              AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

 CARD NO        ****                              CONTENTS                              ****

                      SUBROUTINE EDIT(IOCT,DAT,J)
                      DIMENSION IBUF(128),IHD(40)
                      DIMENSION DAT(1)
                      COMMON IHD
                      COMMON/GETDAT/IRT,IBUF
                      COMMON/PRINT/IPT
                      IF(ABS(DAT(IOCT-1)).GT.10.) GO TO 1
                      IF(ABS(DAT(IOCT)).GT.10.) GO TO 1
                      RETURN
                    1 IOCT=IOCT-2*J
                      IHD(40)=IHD(40)+1
                      DO 2 J=1,16
                      IOCT=IOCT+2
                      DAT(IOCT-1)=9999.
                      DAT(IOCT)=9999.
                    2 CONTINUE
                      RETURN
                      END
```

Program Listing A-48   Frequency Filter Editor

```
09/28/76        INPUT LISTING                              AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE       (LIST,NAMSQ)

 CARD NO        ****                              CONTENTS                              ****

                      SUBROUTINE STAT1
                      DIMENSION IBUF(128),IHD(40)
                      DIMENSION GROTOT(3,32)
                      DOUBLE PRECISION GROTOT,AMAX
                      COMMON IHD,GROTOT
                      COMMON/GETDAT/IRT,IBUF
                      COMMON/PRINT/IPT
                      DO 1 I=1,32
                      IF(GROTOT(3,I).EQ.0) GO TO 1
                      GROTOT(1,I)=GROTOT(1,I)/GROTOT(3,I)
                      GROTOT(2,I)=GROTOT(2,I)/GROTOT(3,I)
                      GROTOT(2,I)=DSQRT(GROTOT(2,I)-GROTOT(1,I)**2)
                    1 CONTINUE
                      I=GROTOT(3,1)+.5
                      WRITE(IPT,1002)I
                      WRITE(IPT,1006)
                      WRITE(IPT,1000)(GROTOT(1,I),I=1,32)
                      WRITE(IPT,1007)
                      WRITE(IPT,1001)(GROTOT(2,I),I=1,32)
                      WRITE(IPT,1003)IHD(37)
                      WRITE(IPT,1004)IHD(39)
                      WRITE(7,1008)
                 1008 FORMAT(10X,'10')
                      WRITE(7,1005)(GROTOT(1,I),I=1,32)
                      WRITE(7,1005)(GROTOT(2,I),I=1,32)
                    3 RETURN
                 1000 FORMAT(1X,16F8.4,/)
                 1001 FORMAT(2X,16F8.4,/)
                 1002 FORMAT('1GRAND TOTALS OVER',I6,' PULSES ARE AS FOLLOWS')
                 1003 FORMAT(//,10X,'TOTAL NUMBER OF REJECTED PULSES =',I5)
                 1004 FORMAT(//,10X,'TOTAL NUMBER OF MISSING OR SHORT RECORDS =',I5)
                 1005 FORMAT(8F9.4)
                 1006 FORMAT(//' MEANS IN VOLTS TIMES 10')
                 1007 FORMAT(//' STANDARD DEVIATIONS ABOUT THE MEANS')
                      END
```

Program Listing A-49   Frequency Filter Statistics

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO        ****                             CONTENTS                                    ****

                      SUBROUTINE PLOT
                      DIMENSION IHD(40),IBUF(128)
                      DIMENSION GRDTOT(3,32),MARK(32)
                      DOUBLE PRECISION GRDTOT
                      COMMON IHD,GRDTOT
                      COMMON/GETDAT/IRT,IBUF
                      COMMON/PRINT/IPT
                      WRITE(IPT,1000)
                      AMX=0
                      DO 1 I=1,32
                      IF(AMX.LT.DABS(GRDTOT(1,I))) AMX=DABS(GRDTOT(1,I))
                    1 CONTINUE
                      MX=AMX+1
                      MD=55/MX
                      DO 10 I=1,55
                      L=55-I
                      IC=1078657024
                      IF(MOD(L,MD).EQ.0) IC=(L/MD)*65536+1089470464
                      DO 20 J=1,32
                      V=DABS(GRDTOT(1,J))
                      MARK(J)=1073741824
                      K=55-MD*V
                      IF(I.NE.K) GO TO 20
                      MARK(J)=-922746880+MOD(J,2)*251658240
                   20 CONTINUE
                   10 WRITE(IPT,1001) IC,MARK
                      WRITE(IPT,1002)
                      WRITE(IPT,1003)
                      RETURN
                 1000 FORMAT('1',3X,16('|',3X),16('/',3X))
                 1001 FORMAT(1X,A2,1X,32(A1,3X))
                 1002 FORMAT(4X,16('|',3X),16('/',3X))
                 1003 FORMAT(24X,'2.5E-6 SECS PER DIVISION',40X,'7.5E-6 SECS PER DIVISIO
                     IN')
                      END
```

Program Listing A-50   Frequency Filter I/Q Plotter

```
09/28/76         INPUT LISTING                          AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO        ****                             CONTENTS                                    ****

                      SUBROUTINE SKIPFL
                      DIMENSION IBUF(128)
                      COMMON/GETDAT/IRT,IBUF
                      COMMON/PRINT/IPT
                    1 CALL GETREC
                      GO TO(1,1,3,2),IRT
                    2 WRITE(IPT,1000)
                    3 RETURN
                 1000 FORMAT(1X,'NO DD CARD THIS FILE (SKIPFL)')
                      END
```

Program Listing A-51   Frequency Filter File Skip

```
09/28/76        INPUT LISTING                         AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE      (LIST,NAMSQ)

  CARD NO         ****                          CONTENTS                               ****

                  SUBROUTINE PLOT1(AVGPWR)
                  DIMENSION DQI(8192)
                  DIMENSION ICH(128)
                  DIMENSION MARK(2),IHD(40),ITIT(2)
                  DOUBLE PRECISION AVGPWR(2),GAP
                  DOUBLE PRECISION ARR(8194,2),GRDTOT(3,32),B(256,2),BMAX,BMIN
                  DOUBLE PRECISION TOTPWR
                  COMMON IHD,GRDTOT,ARR,DQI,B
                  DATA MARK/'    ','****'/
                  DATA ITIT/'QQQQ','IIII'/
                  COMMON/PRINT/IPT
                  DO 6 M=1,2
                  L=0
                  TOTPWR=0.0D0
                  DCPWR=ARR(1,M)**2+ARR(2,M)**2
                  WRITE(IPT,1001)ITIT(M),DCPWR
                  NPNT=2**IHD(25)
                  L1=NPNT/256
                  L2=NPNT-L1+2
                  L3=L1/2
                  DO 2 I=2,L2,L1
                  L=L+1
                  B(L,M)=0.0D0
                  DO 1 J=1,L1,2
                  K=I+J
                1 B(L,M)=B(L,M)+ARR(K,M)**2+ARR(K+1,M)**2
                  TOTPWR=TOTPWR+B(L,M)
                2 CONTINUE
                  BMAX=-9999.
                  BMIN=9999.
                  DO 3 I=1,256
                  BMAX=DMAX1(B(I,M),BMAX)
                  BMIN=DMIN1(B(I,M),BMIN)
                3 CONTINUE
                  SPD=BMAX-BMIN
                  GAP=127/SPD
                  DO 4 I=1,128
                4 ICH(I)=MARK(1)
                  DO 5 I=1,256
                  K=(B(I,M)-BMIN)*GAP+1.01
                  ICH(K)=MARK(2)
                  WRITE(IPT,1000)I,ICH
                  ICH(K)=MARK(1)
                5 CONTINUE
                  AVGPWR(M)=TOTPWR*L1/NPNT
                  WRITE(IPT,1002)BMIN,BMAX,TOTPWR,AVGPWR(M)
                6 CONTINUE
                  RETURN
             1000 FORMAT(1X,I3,128A1)
             1001 FORMAT('1',48X,'TOTAL DC POWER IN',1X,A1,' =',F7.4)
             1002 FORMAT(1H ,'MIN VALUE =',E10.4,4X,'MAX VALUE =',E10.4,4X,
                 1'TOTAL AC POWER =',F7.4,4X,'AVG AC POWER =',F7.4)
                  END
```

Program Listing A-52   Frequency Filter Envelope Plotter

```
FORTRAN MODULE       (LIST,NAMSQ)

CARD NO       ****                    CONTENTS                    ****

            SUBROUTINE HIST
            IMPLICIT REAL*8(A-H,O-Z)
            DIMENSION ARR(8194,2),GRDTOT(3,32),IHD(40)
            DIMENSION JIS(20,20),IBUC(2,20)
            COMMON IHD,GRDTOT,ARR
            COMMON/PRINT/IPT
            SIG6=3*(GRDTOT(2,11)+GRDTOT(2,12))
            SIG=SIG6/6
            ISIG=6
            AINC=2*SIG6/20
           .BNDQ=GRDTOT(1,11)-SIG6
            UBNDQ=GRDTOT(1,11)+SIG6
            BNDI=GRDTOT(1,12)-SIG6
            UBNDI=GRDTOT(1,12)+SIG6
            CALL CLEAR(JIS,400)
            CALL CLEAR(IBUC,40)
            IQ=0
            IA=0
            IAQ=0
            AVQ=0.0
            AVI=0.0
            I1=2**IHD(25)
            DO 20 I=1,I1
            KFLG=0
            LFLG=0
            DO 3 K=1,20
            AQ=AINC*(K-1)+BNDQ
            IF(ARR(I,1).GE.AQ) GO TO 2
            GO TO 4
          2 IF(ARR(I,1).LE.(AQ+AINC)) GO TO 5
          3 CONTINUE
          4 IQ=IQ+1
            KFLG=1
          5 DO 7 L=1,20
            AI=AINC*(L-1)+BNDI
            IF(ARR(I,2).GE.AI) GO TO 6
            GO TO 8
          6 IF(ARR(I,2).LE.(AI+AINC)) GO TO 9
          7 CONTINUE
          8 IA=IA+1
            LFLG=1
          9 IF(KFLG+LFLG-1)11,20,10
         10 IQ=IQ-1
            IA=IA-1
            IAQ=IAQ+1
            GO TO 20
         11 JIS(K,L)=JIS(K,L)+1
            AVQ=AVQ+ARR(I,1)
            AVI=AVI+ARR(I,2)
            IBUC(1,K)=IBUC(1,K)+1
            IBUC(2,L)=IBUC(2,L)+1
            ICNT=ICNT+1
         20 CONTINUE
            I2=2**IHD(25)-IQ-IA-IAQ
            AVQ=AVQ/I2
            AVI=AVI/I2
            WRITE(IPT,1001)
            DO 30 I=1,20
         30 WRITE(IPT,1000)(JIS(21-I,J),J=1,20),IBUC(1,21-I)
            WRITE(IPT,1002)
            WRITE(IPT,1003)(IBUC(2,K),K=1,20)
            WRITE(IPT,1004)I1
            WRITE(IPT,1013)SIG
            WRITE(IPT,1010)ISIG
            WRITE(IPT,1005)IQ
            WRITE(IPT,1006)IA
            WRITE(IPT,1007)IAQ
            WRITE(IPT,1008)AVQ
            WRITE(IPT,1009)AVI
            RETURN
       1000 FORMAT(16X,20I5,4X,I5,//)
       1001 FORMAT('1',56X,'T11-T12 HISTOGRAM',48X,'T11',/)
       1002 FORMAT('1',54X,'T12 DISTRIBUTION')
       1003 FORMAT(16X,20I5///)
       1004 FORMAT(53X,'TOTAL NO. PAIRS     =',I5,/)
       1005 FORMAT(53X,'T11 EDIT PAIRS      =',I4,/)
       1006 FORMAT(53X,'T12 EDIT PAIRS      =',I4,/)
       1007 FORMAT(53X,'T11,12 EDIT PAIRS =',I4,/)
       1008 FORMAT(53X,'T11 AVERAGE         =',F7.4,/)
       1009 FORMAT(53X,'T12 AVERAGE         =',F7.4,/)
       1010 FORMAT(53X,'EDITING LEVEL       =',I2,' SIGMA',/)
       1013 FORMAT(53X,'T11,12 EDIT SIGMA =',F7.4,/)
            END
```

Program Listing A-53 Frequency Filter Histogram Printer

```
FORTRAN MODULE      (LIST,NAMSQ)

  CARD NO        ****                      CONTENTS                      ****

           SUBROUTINE TOA
           IMPLICIT REAL*8(A-C,E-H,O-Z)
           DIMENSION DAT(8192)
           DIMENSION IHD(40),GRDTOT(3,32),ARR(8194,2),TITLE(2)
           DIMENSION IBUC(24),LINE(24),MARK(2),JBUC(24)
           DATA TITLE/'BEFORE  ',' AFTER  '/
           DATA MARK/'    ','****'/
           COMMON IHD,GRDTCT,ARR
           COMMON/CARD/AVG,STD,SN,FS
           COMMON/PRINT/IPT
           CALL CLEAR(DAT,8192)
           DO 100 J=1,2
           GO TO(8,9),J
         8 AMAX=-9995.
           AMIN=9999.
         9 STD=0.0
           AVG=0.0
           ICNT=0
           CALL CLEAR(IBUC,24)
           NPNT=2**IHD(25)
           DO 1 I=1,NPNT
           IF(DAT(I).GT.9000.) GO TO 1
           ICNT=ICNT+1
           GO TO(6,7),J
         6 IF(ARR(I,2).GT.0.0) GO TO 2
           ARR(I,1)=-ARR(I,1)
           ARR(I,2)=-ARR(I,2)
         2 DAT(I)=DATAN2(ARR(I,1),ARR(I,2))*1.591549
           IF(DAT(I).GT.AMAX) AMAX=DAT(I)
           IF(DAT(I).LT.AMIN) AMIN=DAT(I)
         7 AVG=AVG+DAT(I)
           STD=STD+DAT(I)**2
         1 CONTINUE
           AVG=AVG/ICNT
           STD=STD/ICNT
           STD=DSQRT(STD-AVG**2)
           AINC=(AMAX-AMIN)/24
           ICNT=0
           DO 5 I=1,NPNT
           IF(DAT(I).GT.9000.) GO TO 5
           ICNT=ICNT+1
           DO 3 K=1,24
           BUC=AMIN+K*AINC
           IF(DAT(I).LE.BUC) GO TO 4
         3 CONTINUE
           K=K-1
         4 IBUC(K)=IBUC(K)+1
         5 CONTINUE
           MAX=0
           DO 10 I=1,24
        10 IF(IBUC(I).GT.MAX) MAX=IBUC(I)
           DO 11 I=1,24
        11 JBUC(I)=IBUC(I)*49./MAX+1.1
           WRITE(IPT,1000)TITLE(J)
           DO 20 I=1,50
           DO 12 K=1,24
           LINE(K)=MARK(1)
           IF((51-I).EQ.JBUC(K)) LINE(K)=MARK(2)
        12 CONTINUE
           WRITE(IPT,1001)LINE
        20 CONTINUE
           WRITE(IPT,1002)IBUC
           WRITE(IPT,1003)AVG,STD,ICNT
           DO 21 I=1,NPNT
           ADAT=DAT(I)
           IF(DABS(ADAT-AVG).GT.3*STD) DAT(I)=9999.
        21 CONTINUE
       100 CONTINUE
           RETURN
      1000 FORMAT(1H1,43X,'TOA ',A6,' EDITING (3RD CYCLE)',/)
      1001 FORMAT(5X,24(4X,A1))
      1002 FORMAT(5X,24I5,/)
      1003 FORMAT(24X,'AVERAGE TOA =',F8.4,' MICROSECONDS',4X,'S.D. TOA =',
          1F8.4,4X,'NO. OF POINTS =',I5)
           END
```

Program Listing A-54 Frequency Filter TOA Distribution Plotter

```
09/28/76          INPUT LISTING                              AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE        (LIST,NAMSQ)

  CARD NO        ****                          CONTENTS                              ****

                  SUBROUTINE AMP
                  IMPLICIT REAL*8(A-C,E-H,O-Z)
                  DIMENSION IHD(40),GROTOT(3,32),ARR(8194,2),TITLE(2),DQI(8192)
                  DIMENSION IBUC(24),LINE(24),MARK(2),JBUC(24)
                  DATA TITLE/'BEFORE  ',' AFTER  '/
                  DATA MARK/'    ','****'/
                  COMMON IHD,GROTOT,ARR,DQI
                  COMMON/PRINT/IPT
                  DO 100 J=1,2
                  GO TO(8,9),J
                8 AMAX=-9999.
                  AMIN=9999.
                9 STD=0.0
                  AVG=0.0
                  ICNT=0
                  CALL CLEAR(IBUC,24)
                  NPNT=2**IHD(25)
                  DO 1 I=1,NPNT
                  IF(DQI(I).GT.9000.) GO TO 1
                  ICNT=ICNT+1
                  GO TO(6,7),J
                6 IF(DQI(I).GT.AMAX)AMAX=DQI(I)
                  IF(DQI(I).LT.AMIN)AMIN=DQI(I)
                7 AVG=DQI(I)+AVG
                  STD=DQI(I)**2+STD
                1 CONTINUE
                  AVG=AVG/ICNT
                  STD=STD/ICNT
                  STD=DSQRT(STD-AVG**2)
                  AINC=(AMAX-AMIN)/24
                  ICNT=0
                  DO 5 I=1,NPNT
                  IF(DQI(I).GT.9000.) GO TO 5
                  ICNT=ICNT+1
                  DO 3 K=1,24
                  BUC=AMIN+K*AINC
                  IF(DQI(I).LE.BUC) GO TO 4
                3 CONTINUE
                  K=K-1
                4 IBUC(K)=IBUC(K)+1
                5 CONTINUE
                  MAX=0
                  DO 10 I=1,24
               10 IF(IBUC(I).GT.MAX) MAX=IBUC(I)
                  DO 11 I=1,24
               11 JBUC(I)=IBUC(I)*49./MAX+1.1
                  WRITE(IPT,1000) TITLE(J),IHD(26)
                  DO 20 I=1,50
                  DO 12 K=1,24
                  LINE(K)=MARK(1)
                  IF((51-I).EQ.JBUC(K)) LINE(K)=MARK(2)
               12 CONTINUE
                  WRITE(IPT,1001)LINE
               20 CONTINUE
                  WRITE(IPT,1002) IBUC
                  WRITE(IPT,1003)AVG,STD,ICNT
                  DO 21 I=1,NPNT
                  QI=DQI(I)
                  IF(DABS(QI-AVG).GT.3*STD) DQI(I)=9999.
               21 CONTINUE
              100 CONTINUE
                  IF(IHD(26).EQ.12) RETURN
                  GROTOT(1,IHD(26))=AVG
                  GROTOT(2,IHD(26))=STD
                  RETURN
             1000 FORMAT(1H1,45X,'AMPLITUDE ',A6,' EDITING',2X,'(SAMPLE ',I2,')',/)
             1001 FORMAT(5X,24(4X,A1))
             1002 FORMAT(5X,24I5,/)
             1003 FORMAT(27X,'AVERAGE AMPLITUDE =',F8.4,' VOLTS',4X,'S.D. AMPLITUDE
                 1=',F8.4,4X,'NO. OF POINTS =',I5,/)
                  END
```

Program Listing A-55   Frequency Filter Amplitude Distribution Plotter

```
09/28/76          INPUT LISTING                      AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE        (LIST,NAMSQ)

 CARD NO          ****                          CONTENTS                                ****

                        SUBROUTINE EDITF(AVGPWR)
                        IMPLICIT REAL*8(A-C,E-H,O-Z)
                        DIMENSION B(256,2),AVGPWR(2),DQI(8192)
                        DIMENSION ARR(8194,2),IHD(40),GRDTOT(3,32)
                        COMMON IHD,GRDTOT,ARR,DQI,B
                        COMMON/PRINT/IPT
                        NPNT=2**IHD(25)
                        WRITE(IPT,1000)
                        DO 100 I=1,2
                        ICNT=0
                        L1=NPNT/256
                        DO 10 J=1,256
                        IF(B(J,I).LT.IHD(27)*AVGPWR(I)) GO TO 10
                        L2=(J-3)*L1+3
                        L3=L2+5*L1-1
                        IF(L2.LT.3) L2=3
                        DO 5 K=L2,L3
                        IF(K.GT.8194) GO TO 5
                        IF(ARR(K,I).EQ.0) GO TO 5
                        ARR(K,I)=0.0D0
                        ICNT=ICNT+1
                      5 CONTINUE
                     10 CONTINUE
                        II=10+I
                        WRITE(IPT,1001)ICNT,II
                    100 CONTINUE
                        RETURN
                   1000 FORMAT(1H1,45X,'ALL OUTPUT DATA',/,46X,'FOLLOWING THIS SECTION',/,
                       145X,'WILL BE FREQUENCY',/,50X,'FILTERED',////)
                   1001 FORMAT(40X,I4,' POINTS FILTERED OUT ON T',I2,/)
                        END
```

Program Listing A-56   Frequency Filter Notch

```
09/28/76          INPUT LISTING                      AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE        (LIST,NAMSQ)

 CARD NO          ****                          CONTENTS                                ****

                        SUBROUTINE MVAMP
                        IMPLICIT REAL*8(A-C,E-H,O-Z)
                        DIMENSION IHD(40),GRDTOT(3,32),ARR(8194,2),DQI(8192)
                        COMMON IHD,GRDTOT,ARR,DQI
                        COMMON/PRINT/IPT
                        NPNT=2**IHD(25)
                        DO 1 I=1,NPNT
                        DQI(I)=ARR(I,2)
                      1 CONTINUE
                        RETURN
                        END
```

Program Listing A-57   Frequency Filter Data Selector

```
09/28/76          INPUT LISTING                      AUTOFLOW CHART SET - LORAN 3  GROUP PHASE FILTER

FORTRAN MODULE        (LIST,NAMSQ)

 CARD NO          ****                          CONTENTS                                ****

                        SUBROUTINE SNFS(JCHK,AEF,I)
                        IMPLICIT REAL*8(A-C,E-H,O-Z)
                        DIMENSION JCHK(5),IHD(40),GRDTOT(3,32),TIT(2)
                        DATA TIT/'BEFORE  ',' AFTER   '/
                        COMMON IHD,GRDTOT
                        COMMON/CARD/TDA,SDTCA,SN,FS
                        COMMON/PRINT/IPT
                        AMP=DABS(GRDTOT(1,IHD(26)))
                        SD=GRDTOT(2,IHD(26))
                        SN=20.*DLOG10(AMP/SD)
                        PWR=(IHD(5)-JCHK(4)+100.)/20.D0
                        FS=.707107*AMP*10**PWR/AEF
                        WRITE(IPT,1000)TIT(I)
                        WRITE(IPT,1001)SN,FS,IHD(26)
                        RETURN
                   1000 FORMAT(52X,A6,' EDITING')
                   1001 FORMAT(35X,'SIGNAL TO NOISE RATIO = ',F5.1,' DB',/,
                       135X,'FIELD STRENGTH = ',F7.0,' MICROVOLTS PER METER',/,
                       250X,'BOTH MEASUREMENTS BASED ON T',I2)
                        END
```

Program Listing A-58   Frequency Filter Signal-to-Noise and Field Strength Calculator

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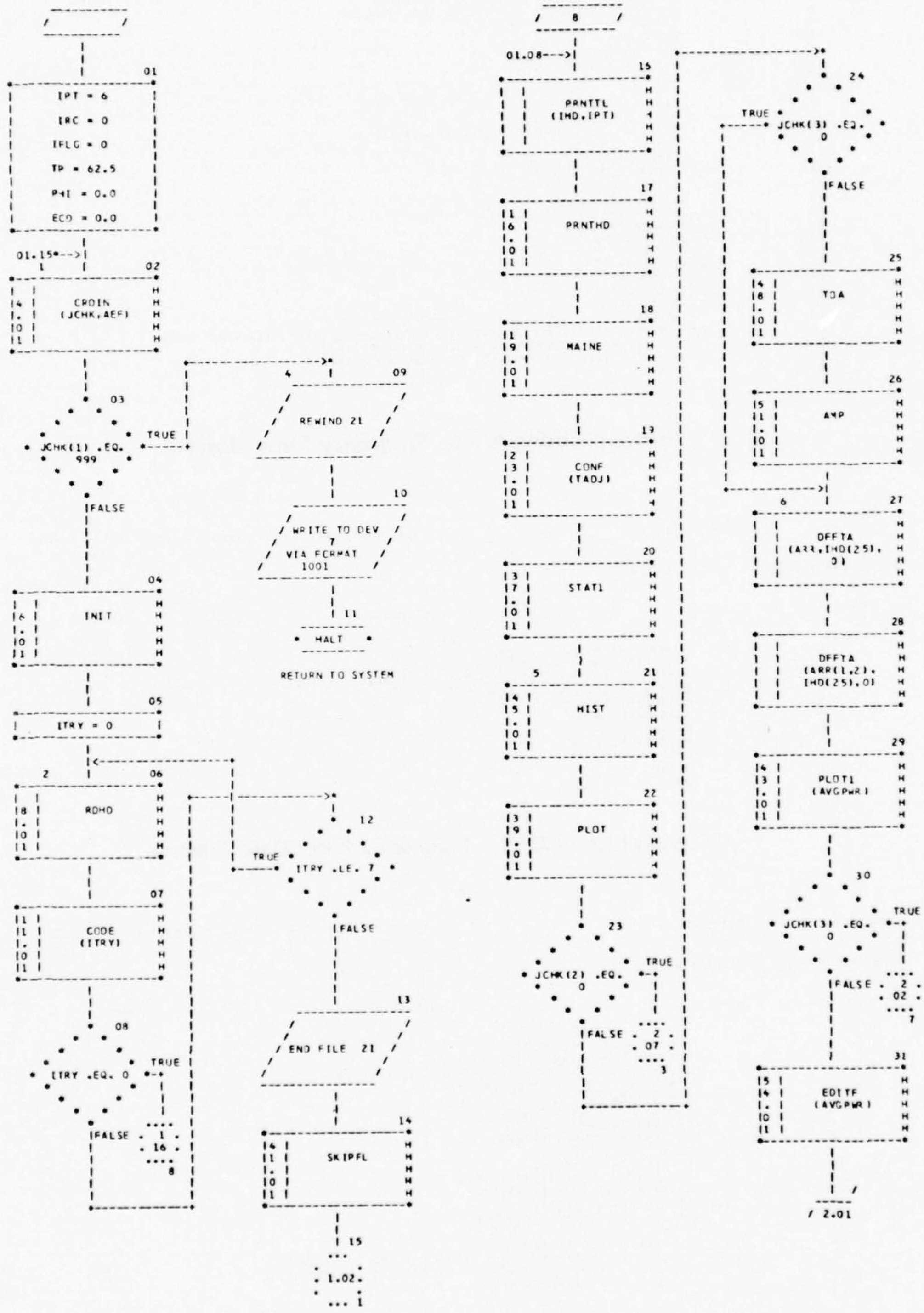
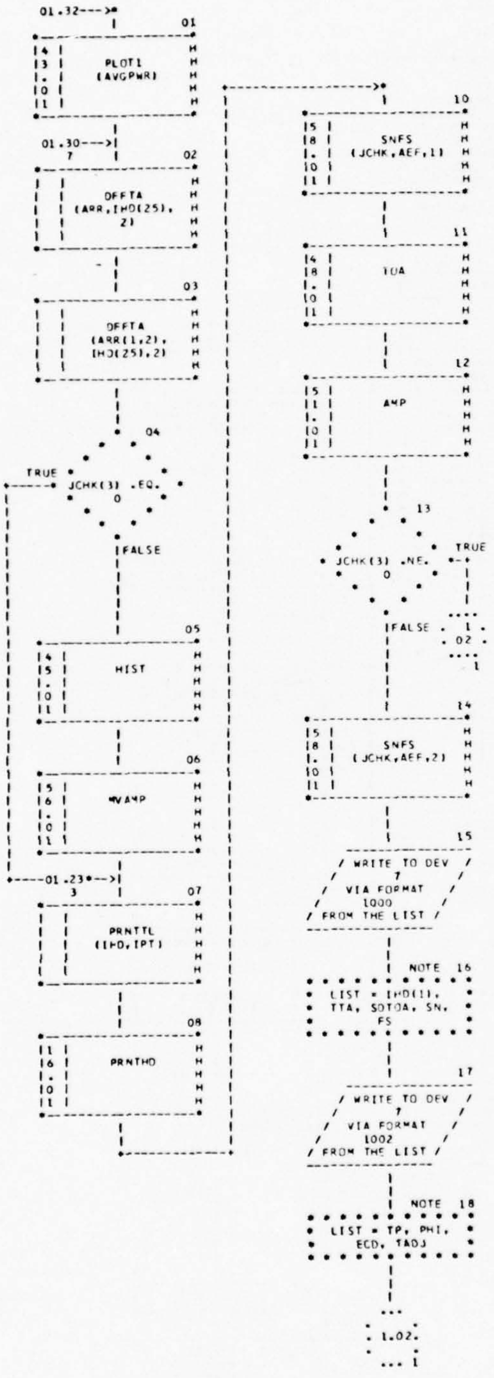
CHART TITLE - PROCEDURES



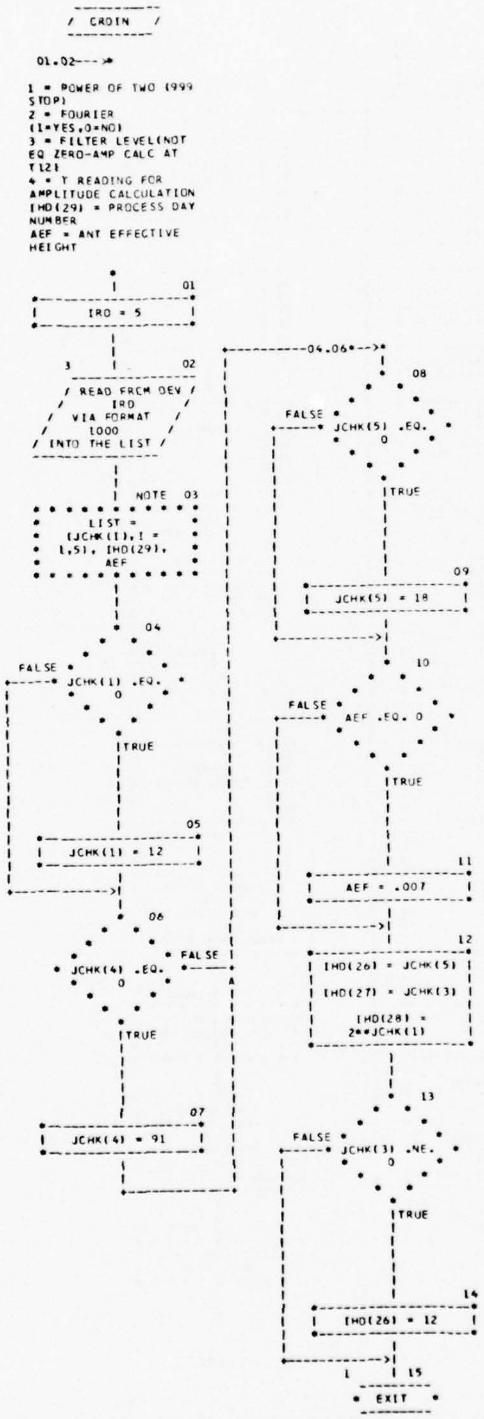
Flow Chart A-34 Frequency Filter Driver

CHART TITLE - PROCEDURES



Flow Chart A-34 Frequency Filter Driver (concluded)

CHART TITLE - SUBROUTINE CRDIN(JCHK,AEF)



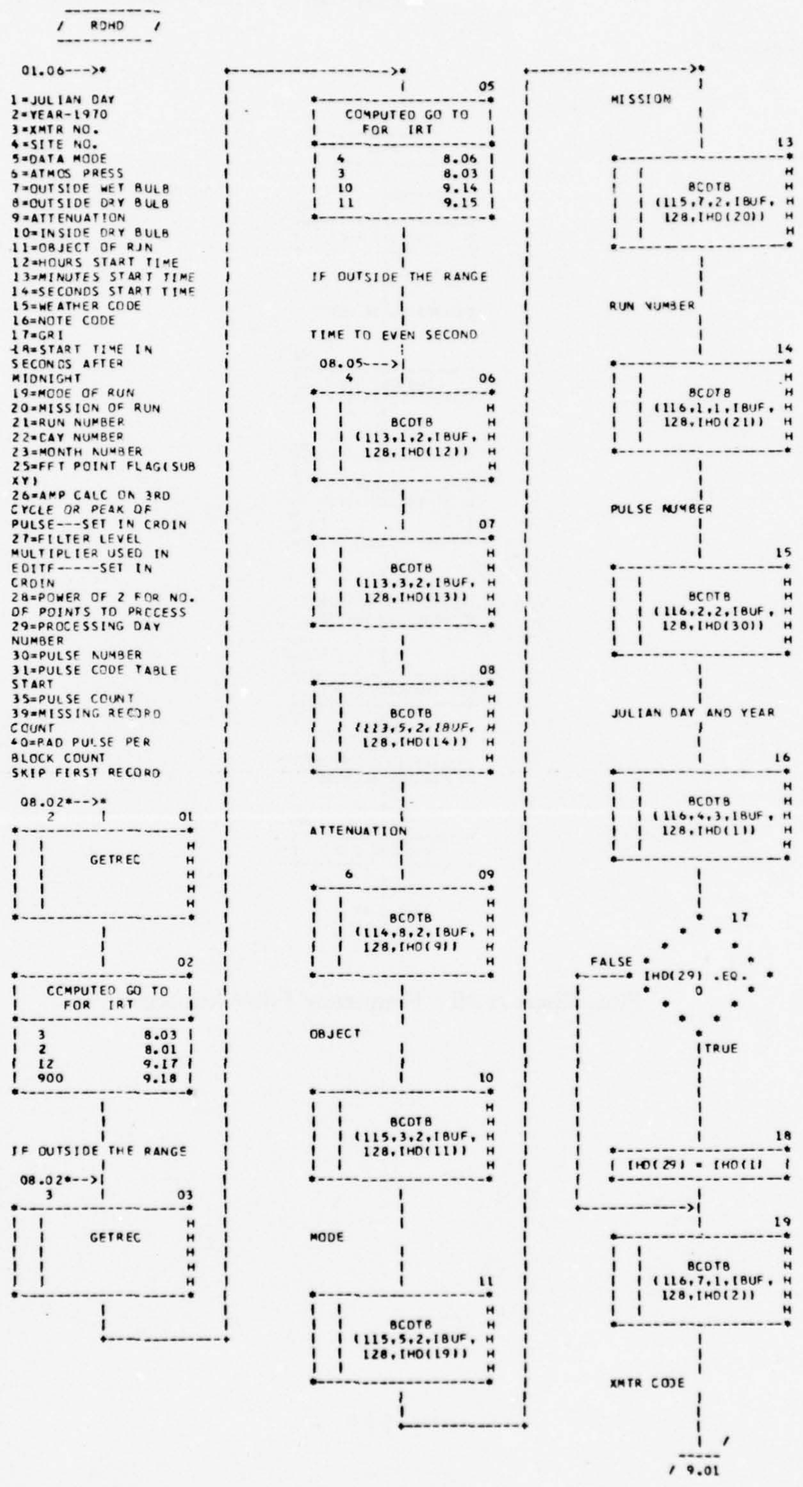
Flow Chart A-35 Frequency Filter Card Input

```
CHART TITLE - SUBROUTINE  INIT


                   ----------
                  /  INIT   /
                  ----------
                       I
            01.04--->I
                       I            01
            *-----------------------*
            I     IHD(25) = 0       I
            *-----------------------*
                       I
                       I
            IHD(35)=PULSE COUNT
                       I
                       I
                       I            02
            *-----------------------*
            I     IHD(35) = 0       I
            *-----------------------*
                       I
                       I
                       I            03
            *-----------------------*
            I I                     H
            I I       CLEAR         H
            I I    (GRDTOT,192)     H
            I I                     H
            I I                     H
            *-----------------------*
                       I
                       I
                       I
            IHD(37) IS TOTAL NO.
            OF REJECTED PULSES
                       I
                       I
                       I            04
            *-----------------------*
            I     IHD(37) = 0       I
            *-----------------------*
                       I
                       I
                       I
            IHD(38) IS TOTAL NO
            OF MISSING RECORDS
                       I
                       I
                       I            05
            *-----------------------*
            I     IHD(38) = 0       I
            *-----------------------*
                       I
                       I
                       I 06
                  ---------
                  * EXIT  *
                  ---------
```

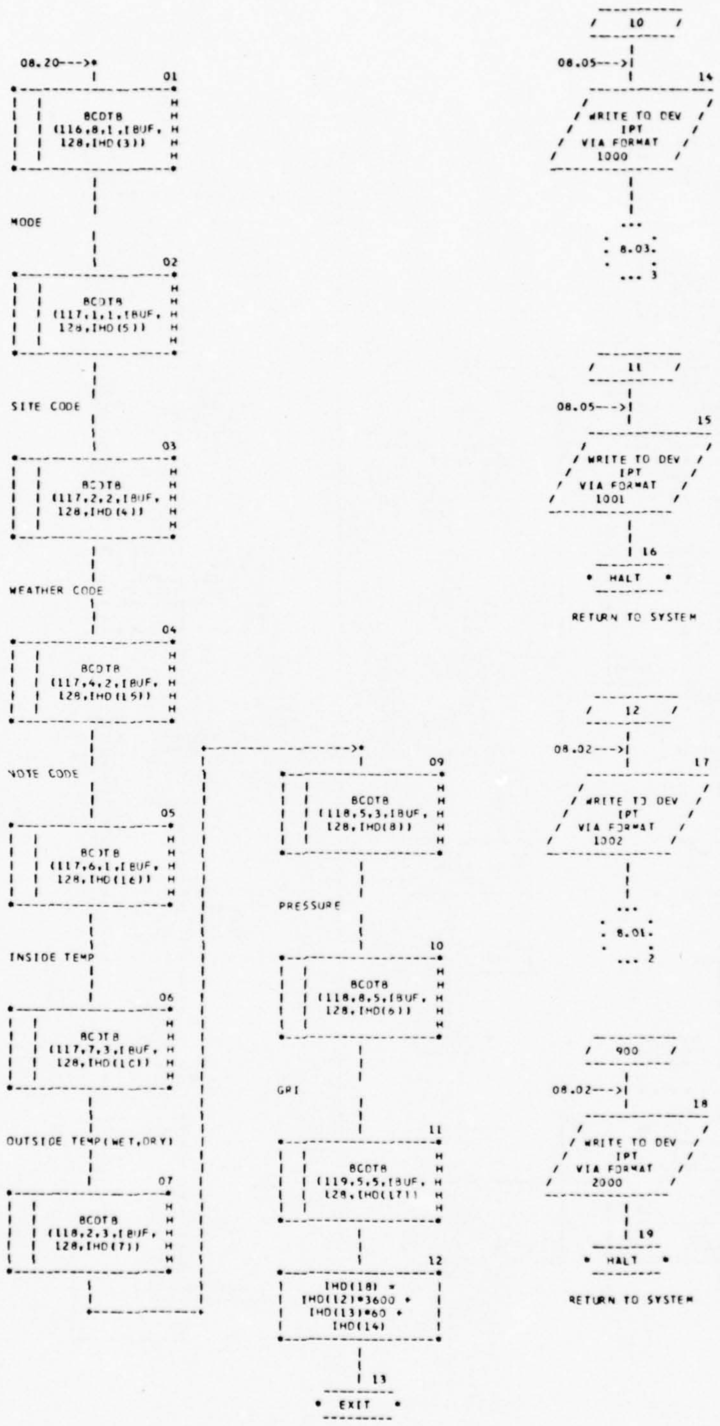
Flow Chart A-36   Frequency Filter Initializer

CHART TITLE - SUBROUTINE RDHD



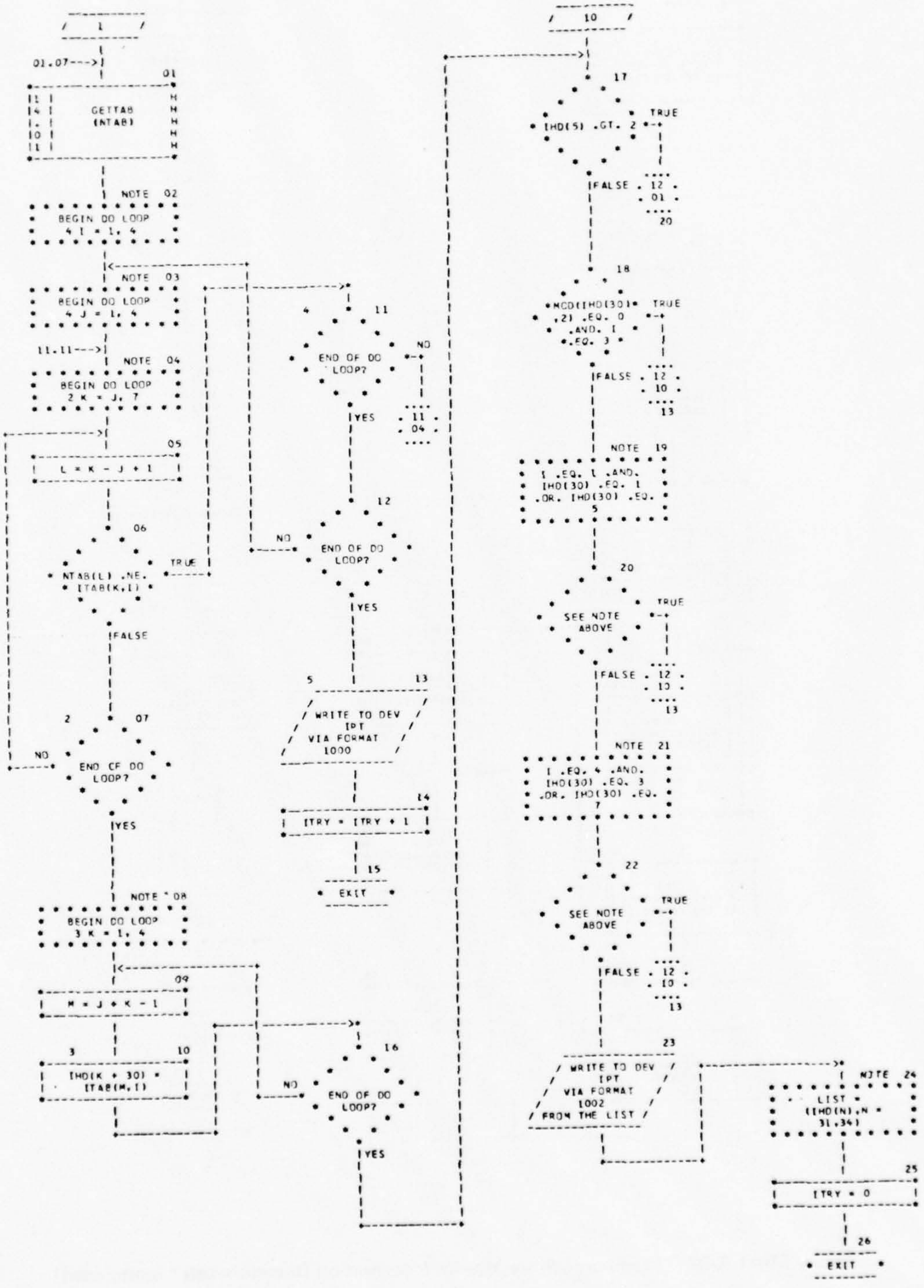
Flow Chart A-37 Frequency Filter Header Information Decommutator

CHART TITLE - SUBROUTINE RDHD


08.20--->*
01
BCDTB (116,8,1,IBUF, 128,IHD(3))
MODE
02
BCDTB (117,1,1,IBUF, 128,IHD(5))
SITE CODE
03
BCDTB (117,2,2,IBUF, 128,IHD(4))
WEATHER CODE
04
BCDTB (117,4,2,IBUF, 128,IHD(15))
NOTE CODE
05
BCDTB (117,6,1,IBUF, 128,IHD(16))
INSIDE TEMP
06
BCDTB (117,7,3,IBUF, 128,IHD(10))
OUTSIDE TEMP(WET,DRY)
07
BCDTB (118,2,3,IBUF, 128,IHD(7))
09
BCDTB (118,5,3,IBUF, 128,IHD(8))
PRESSURE
10
BCDTB (118,8,5,IBUF, 128,IHD(6))
GRI
11
BCDTB (119,5,5,IBUF, 128,IHD(17))
12
IHD(18) = IHD(12)*3600 + IHD(13)*60 + IHD(14)
13
EXIT
10
08.05--->
14
WRITE TO DEV IPT VIA FORMAT 1000
8.03
3
11
08.05--->
15
WRITE TO DEV IPT VIA FORMAT 1001
16
HALT
RETURN TO SYSTEM
12
08.02--->
17
WRITE TO DEV IPT VIA FORMAT 1002
8.01
2
900
08.02--->
18
WRITE TO DEV IPT VIA FORMAT 2000
19
HALT
RETURN TO SYSTEM

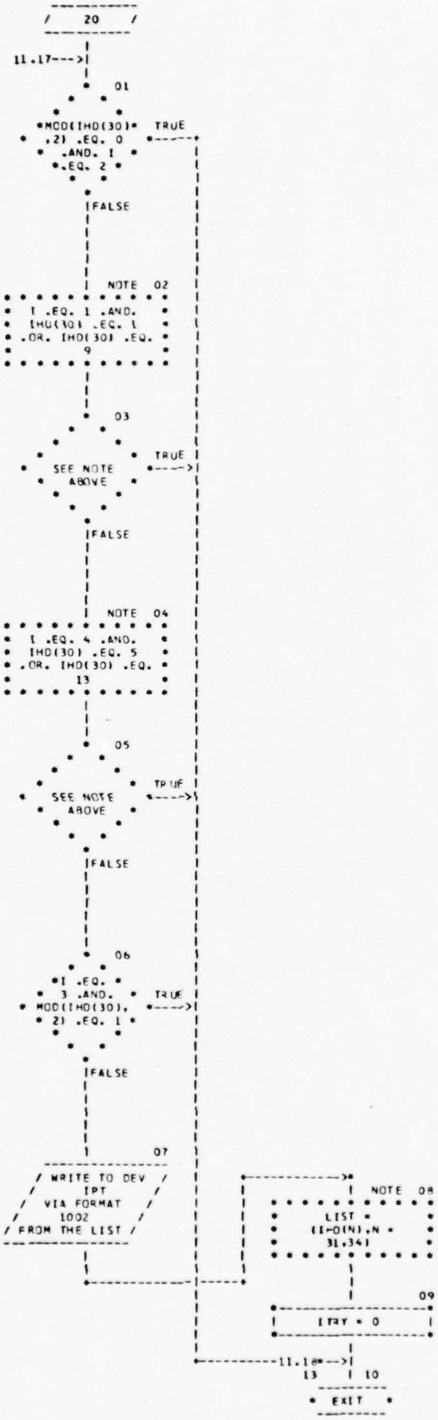
Flow Chart A-37 Frequency Filter Header Information Decommutator (concluded)

CHART TITLE - SUBROUTINE CODE(ITRY)



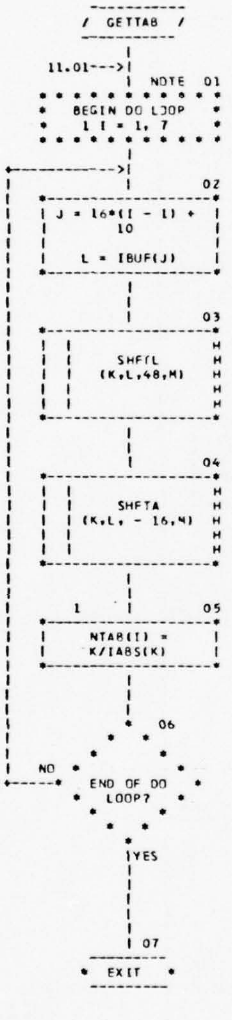
Flow Chart A-38 Frequency Filter Pulse Phase Code Decoder

CHART TITLE - SUBROUTINE CODE(ITRY)


20
11.17--->
01
MOD(IHD(30),2) .EQ. 0 .AND. I .EQ. 2
TRUE
FALSE
NOTE 02
I .EQ. 1 .AND. IHD(30) .EQ. 1 .OR. IHD(30) .EQ. 9
03
SEE NOTE ABOVE
TRUE
FALSE
NOTE 04
I .EQ. 4 .AND. IHD(30) .EQ. 5 .OR. IHD(30) .EQ. 13
05
SEE NOTE ABOVE
TRUE
FALSE
06
I .EQ. 3 .AND. MOD(IHD(30), 2) .EQ. 1
TRUE
FALSE
07
WRITE TO DEV IPT VIA FORMAT 1002 FROM THE LIST
NOTE 08
LIST = (IHO(N),N = 31,34)
09
ITRY = 0
11.18--->
13
10
EXIT

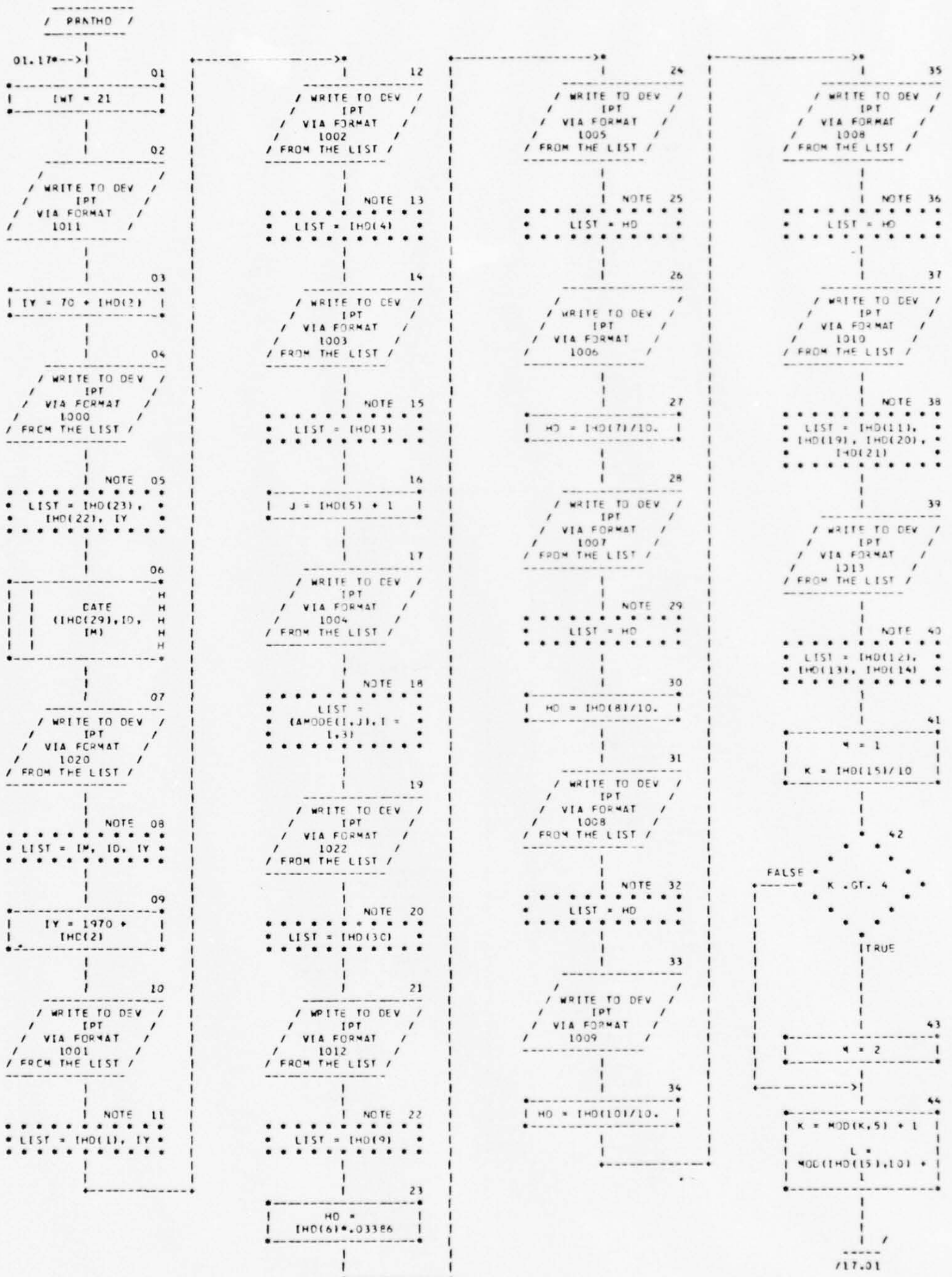
Flow Chart A-38 Frequency Filter Pulse Phase Code Decoder (concluded)

CHART TITLE - SUBROUTINE GETTAB(NTAB)



Flow Chart A-39 Frequency Filter Phase Code Generator

CHART TITLE - SUBROUTINE PRNTHO


PRNTHO
01.17*-->
01
IWT = 21
02
WRITE TO DEV IPT VIA FORMAT 1011
03
IY = 70 + IHD(2)
04
WRITE TO DEV IPT VIA FORMAT 1000 FROM THE LIST
NOTE 05
LIST = IHD(23), IHD(22), IY
06
DATE (IHD(29),ID, IM)
07
WRITE TO DEV IPT VIA FORMAT 1020 FROM THE LIST
NOTE 08
LIST = IM, ID, IY
09
IY = 1970 + IHD(2)
10
WRITE TO DEV IPT VIA FORMAT 1001 FROM THE LIST
NOTE 11
LIST = IHD(1), IY
12
WRITE TO DEV IPT VIA FORMAT 1002 FROM THE LIST
NOTE 13
LIST = IHD(4)
14
WRITE TO DEV IPT VIA FORMAT 1003 FROM THE LIST
NOTE 15
LIST = IHD(3)
16
J = IHD(5) + 1
17
WRITE TO DEV IPT VIA FORMAT 1004 FROM THE LIST
NOTE 18
LIST = (AMODE(I,J),I = 1,3)
19
WRITE TO DEV IPT VIA FORMAT 1022 FROM THE LIST
NOTE 20
LIST = IHD(30)
21
WRITE TO DEV IPT VIA FORMAT 1012 FROM THE LIST
NOTE 22
LIST = IHD(9)
23
HO = IHD(6)*.03386
24
WRITE TO DEV IPT VIA FORMAT 1005 FROM THE LIST
NOTE 25
LIST = HO
26
WRITE TO DEV IPT VIA FORMAT 1006
27
HO = IHD(7)/10.
28
WRITE TO DEV IPT VIA FORMAT 1007 FROM THE LIST
NOTE 29
LIST = HO
30
HO = IHD(8)/10.
31
WRITE TO DEV IPT VIA FORMAT 1008 FROM THE LIST
NOTE 32
LIST = HO
33
WRITE TO DEV IPT VIA FORMAT 1009
34
HO = IHD(10)/10.
35
WRITE TO DEV IPT VIA FORMAT 1008 FROM THE LIST
NOTE 36
LIST = HO
37
WRITE TO DEV IPT VIA FORMAT 1010 FROM THE LIST
NOTE 38
LIST = IHD(11), IHD(19), IHD(20), IHD(21)
39
WRITE TO DEV IPT VIA FORMAT 1013 FROM THE LIST
NOTE 40
LIST = IHD(12), IHD(13), IHD(14)
41
M = 1
K = IHD(15)/10
42
K .GT. 4
FALSE
TRUE
43
M = 2
44
K = MOD(K,5) + 1
L = MOD(IHD(15),10) + 1
/17.01

Flow Chart A-40 Frequency Filter Header Page Printer

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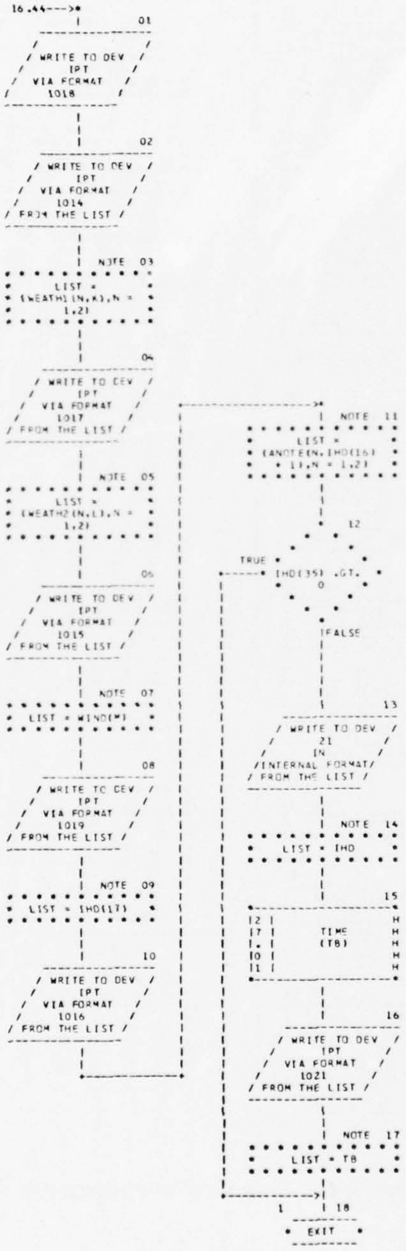
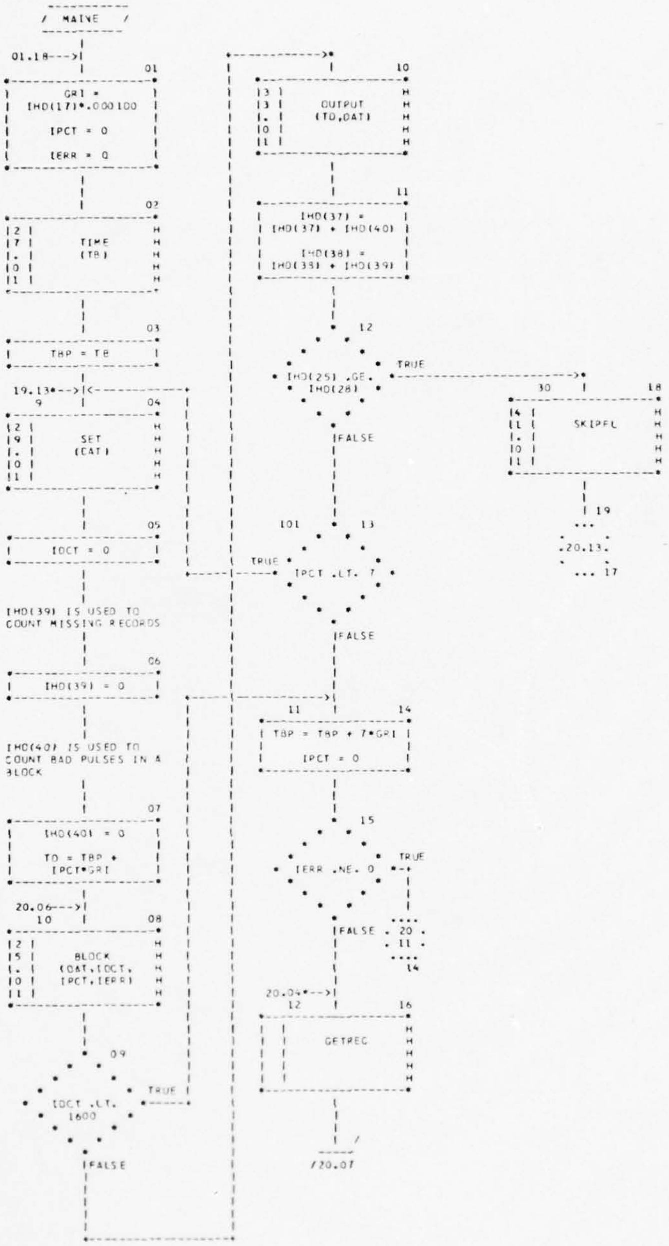
CHART TITLE - SUBROUTINE PRNTHD

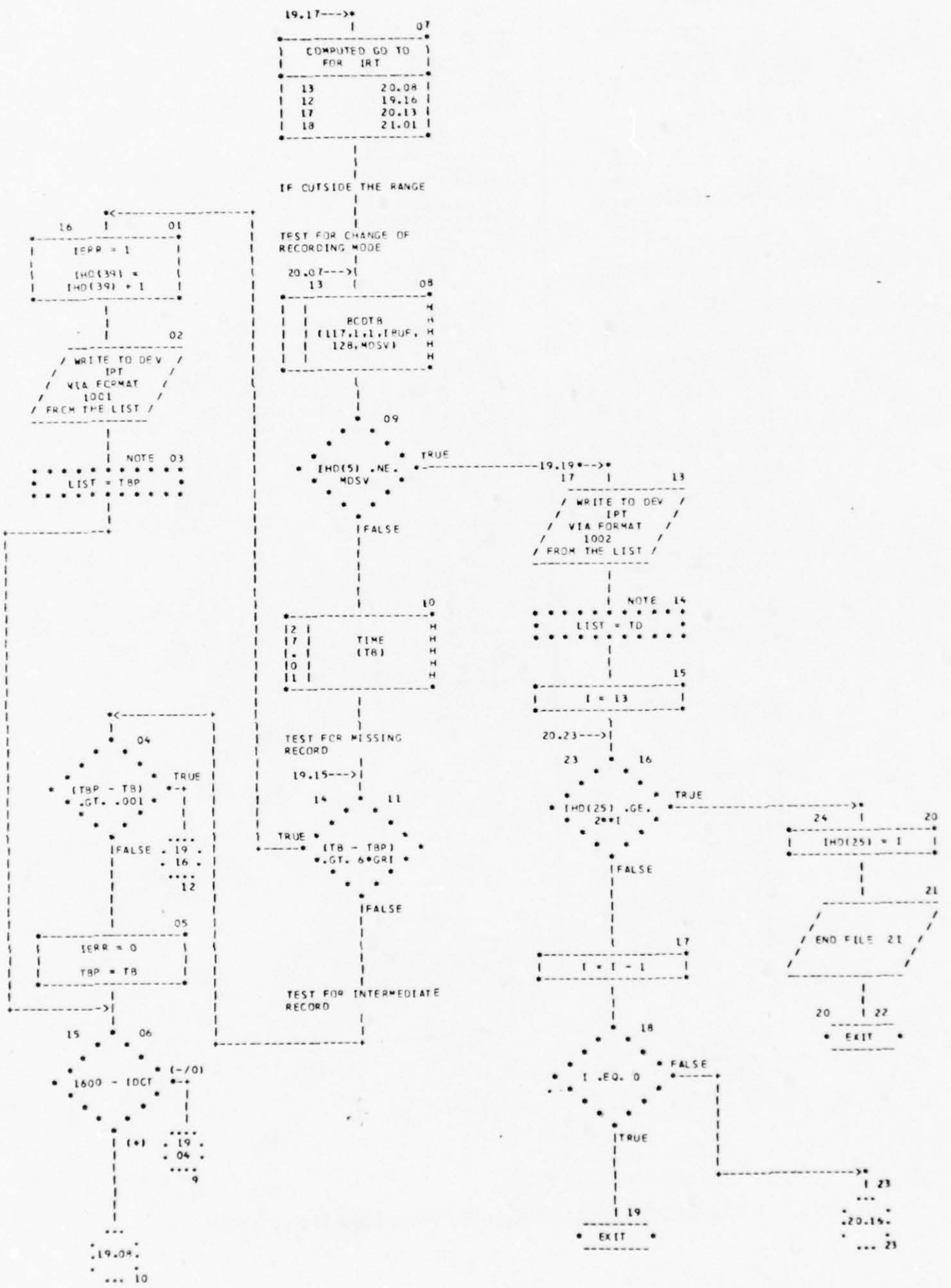

16.44--->
01
WRITE TO DEV IPT VIA FORMAT 1018
02
WRITE TO DEV IPT VIA FORMAT 1014 FROM THE LIST
NOTE 03
LIST = (WEATH1(N,K),N = 1,2)
04
WRITE TO DEV IPT VIA FORMAT 1017 FROM THE LIST
NOTE 05
LIST = (WEATH2(N,L),N = 1,2)
06
WRITE TO DEV IPT VIA FORMAT 1015 FROM THE LIST
NOTE 07
LIST = WIND(M)
08
WRITE TO DEV IPT VIA FORMAT 1019 FROM THE LIST
NOTE 09
LIST = IHD(17)
10
WRITE TO DEV IPT VIA FORMAT 1016 FROM THE LIST
NOTE 11
LIST = (ANOTE(N,IHD(16) + 1),N = 1,2)
12
TRUE
IHD(35) .GT. 0
FALSE
13
WRITE TO DEV 21 IN INTERNAL FORMAT FROM THE LIST
NOTE 14
LIST = IHD
15
2
7
.
0
1
TIME (TB)
H
H
H
H
H
16
WRITE TO DEV IPT VIA FORMAT 1021 FROM THE LIST
NOTE 17
LIST = TB
1
18
EXIT

Flow Chart A-40 Frequency Filter Header Page Printer (concluded)

CHART TITLE - SUBROUTINE MAINE



Flow Chart A-41 Frequency Filter Main Data Handler



Flow Chart A-41 Frequency Filter Main Data Handler (continued)

```
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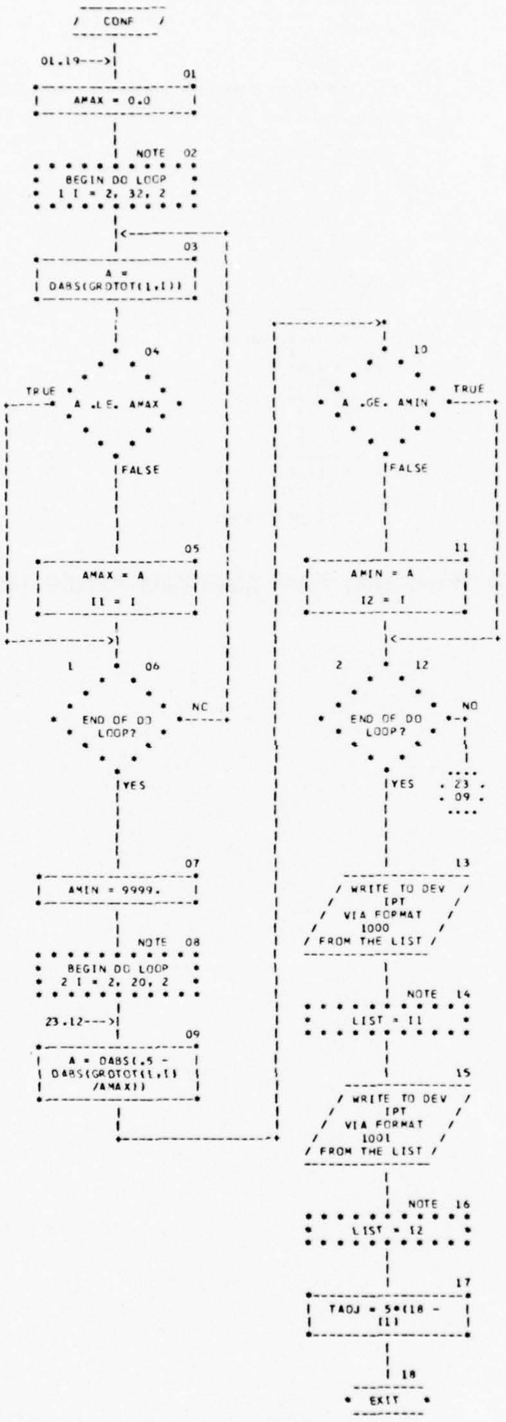
CHART TITLE - SUBROUTINE  MAINE


                                   -----------
                                  /    18    /
                                  -----------
                                       I
                              20.07--->I
                                       I          01
                                  ---------------
                                  /             /
                                 / WRITE TO DEV /
                                /      IPT     /
                               /  VIA FORMAT  /
                              /    1000      /
                              ---------------
                                       I
                                       I
                                       I 02
                                   ---------
                                   *  HALT  *
                                   ---------

                                RETURN TO SYSTEM
```

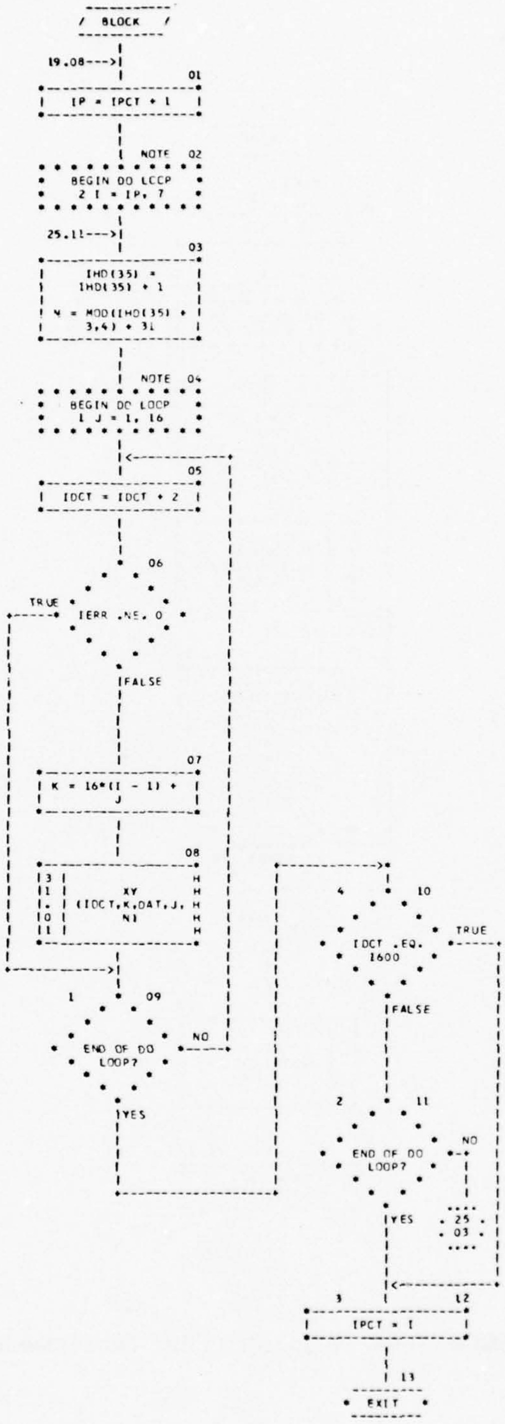
Flow Chart A-41 Frequency Filter Main Data Handler (concluded)

CHART TITLE - SUBROUTINE CONF(TADJ)



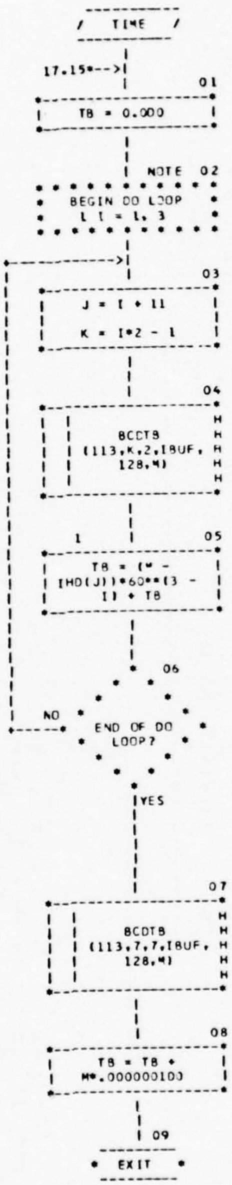
Flow Chart A-42 Frequency Filter Lock-On Confirmation

CHART TITLE - SUBROUTINE BLOCK(DAT,IDCT,IPCT,IERR)



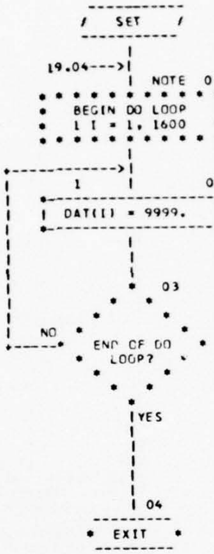
Flow Chart A-43 Frequency Filter Data Blocker

CHART TITLE - SUBROUTINE TIME(TB)



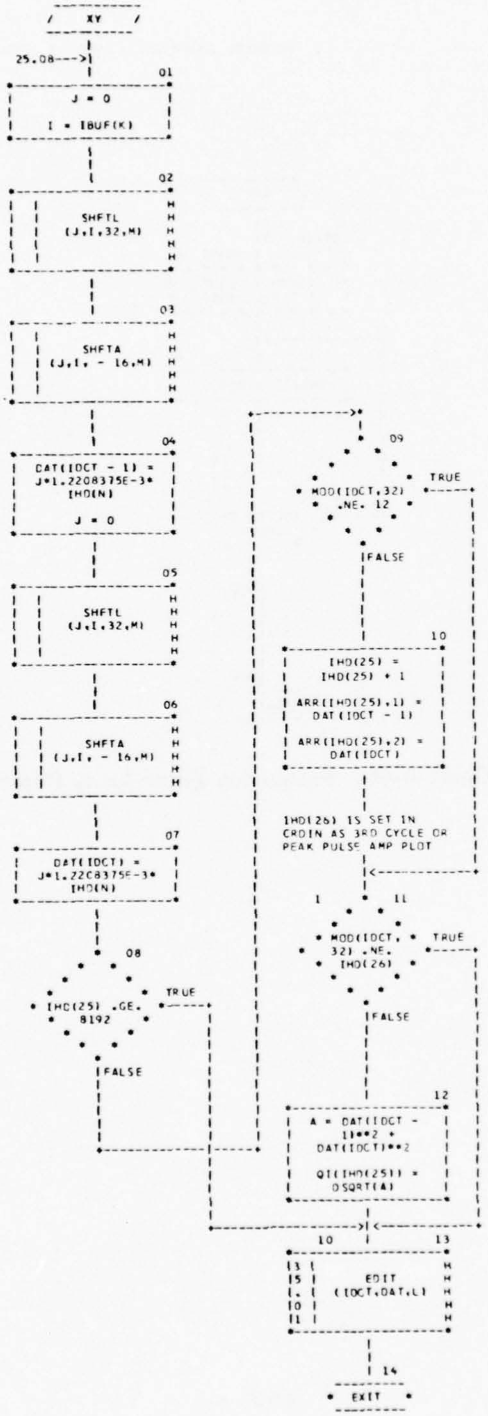
Flow Chart A-44 Frequency Filter Time Decoder

CHART TITLE - SUBROUTINE SET(DAT)



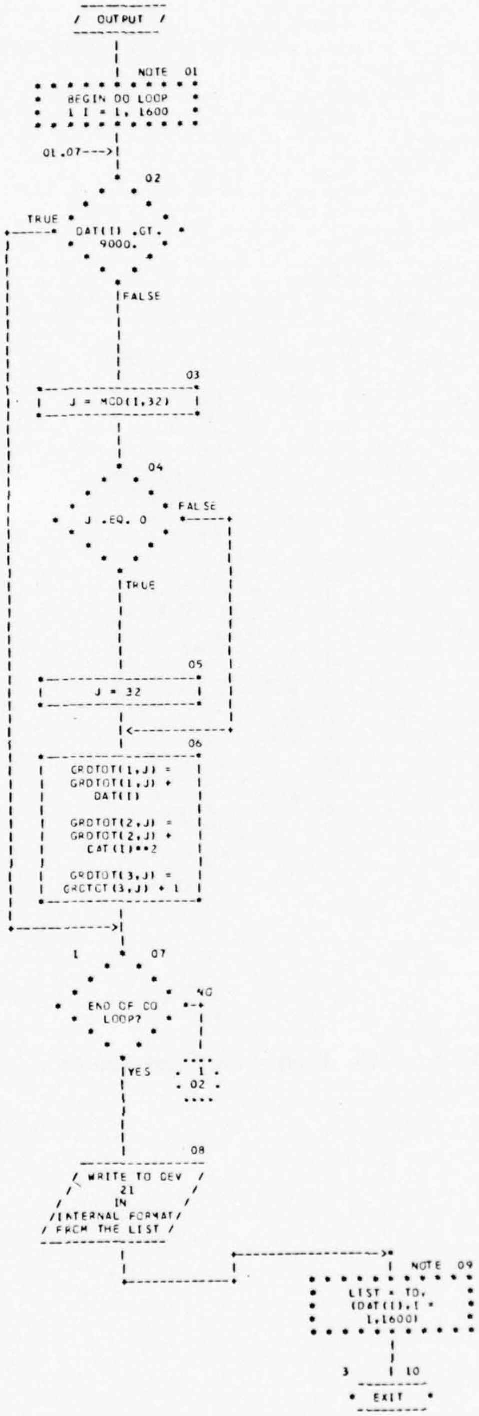
Flow Chart A-45 Frequency Filter Array Reset

CHART TITLE - SUBROUTINE XY(IDCT,K,CAT,L,N)



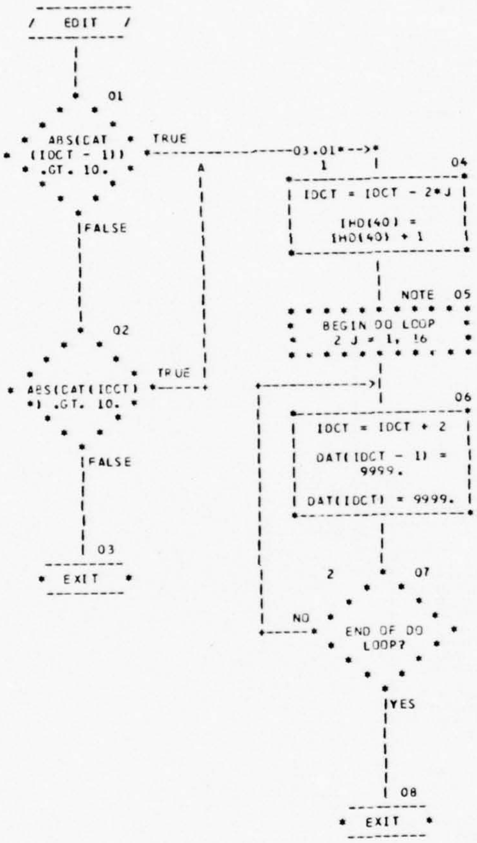
Flow Chart A-46 Frequency Filter Measurement Decoder

CHART TITLE - SUBROUTINE OUTPUT(TD,DAT)


OUTPUT
NOTE 01
BEGIN DO LOOP
1 I = 1, 1600
01,07--->
02
TRUE
DAT(I) .GT. 9000.
FALSE
03
J = MOD(I,32)
04
J .EQ. 0
FALSE
TRUE
05
J = 32
06
GRDTOT(1,J) = GRDTOT(1,J) + DAT(I)
GRDTOT(2,J) = GRDTOT(2,J) + DAT(I)**2
GRDTOT(3,J) = GRDTOT(3,J) + 1
1
07
END OF DO LOOP?
NO
1
02
YES
08
WRITE TO DEV 21 IN INTERNAL FORMAT FROM THE LIST
NOTE 09
LIST = TD, (DAT(I),I = 1,1600)
3
10
EXIT

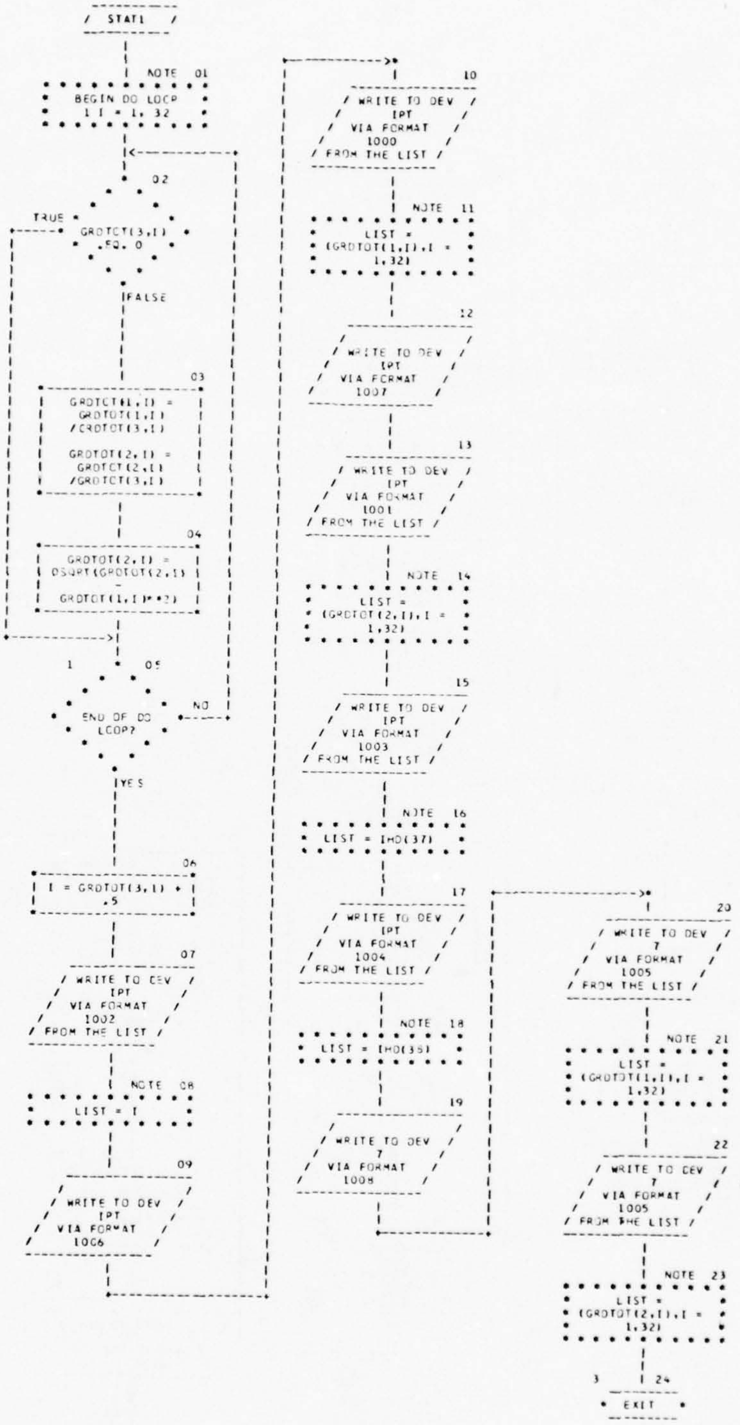
Flow Chart A-47 Frequency Filter Output Tape Writer

CHART TITLE - SUBROUTINE EDIT(ICCT,CAT,J)



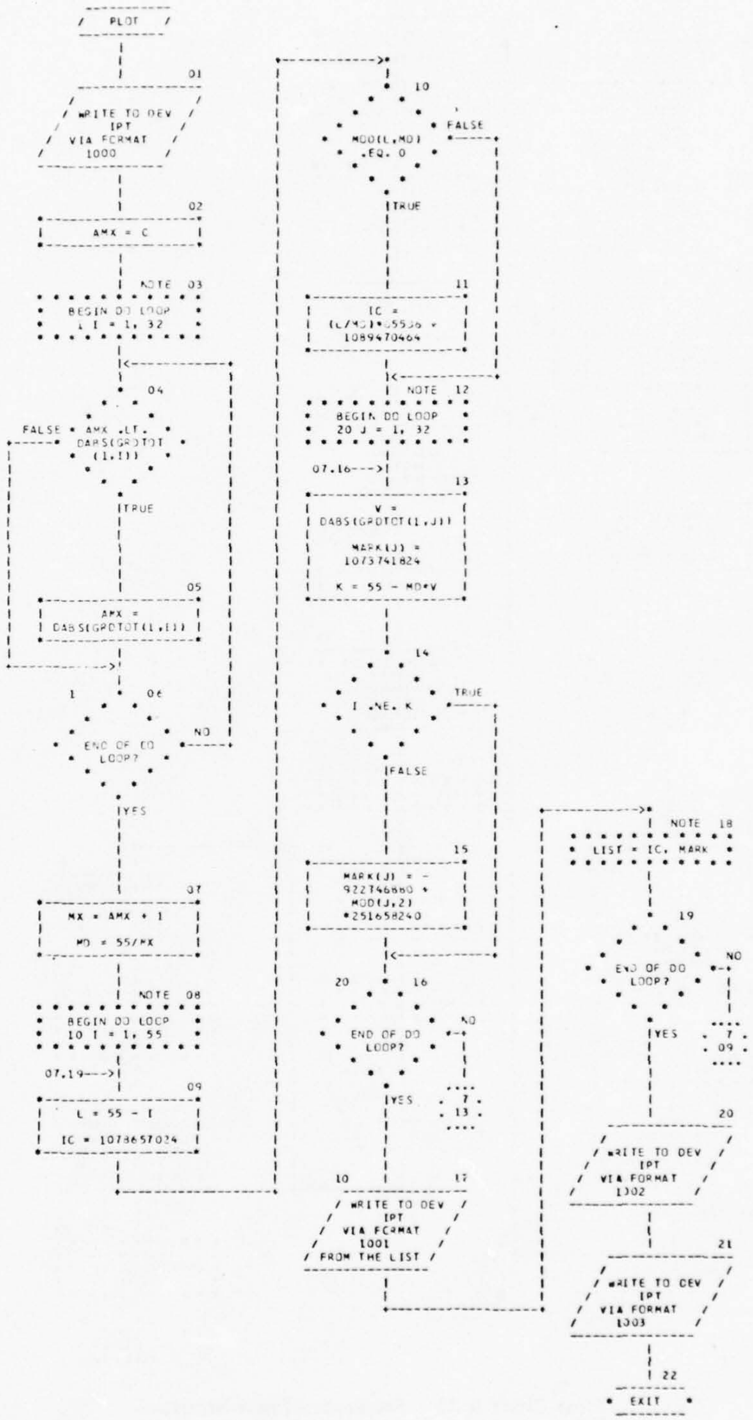
Flow Chart A-48 Frequency Filter Editor

CHART TITLE - SUBROUTINE STAT1



Flow Chart A-49 Frequency Filter Statistics

CHART TITLE - SUBROUTINE PLOT



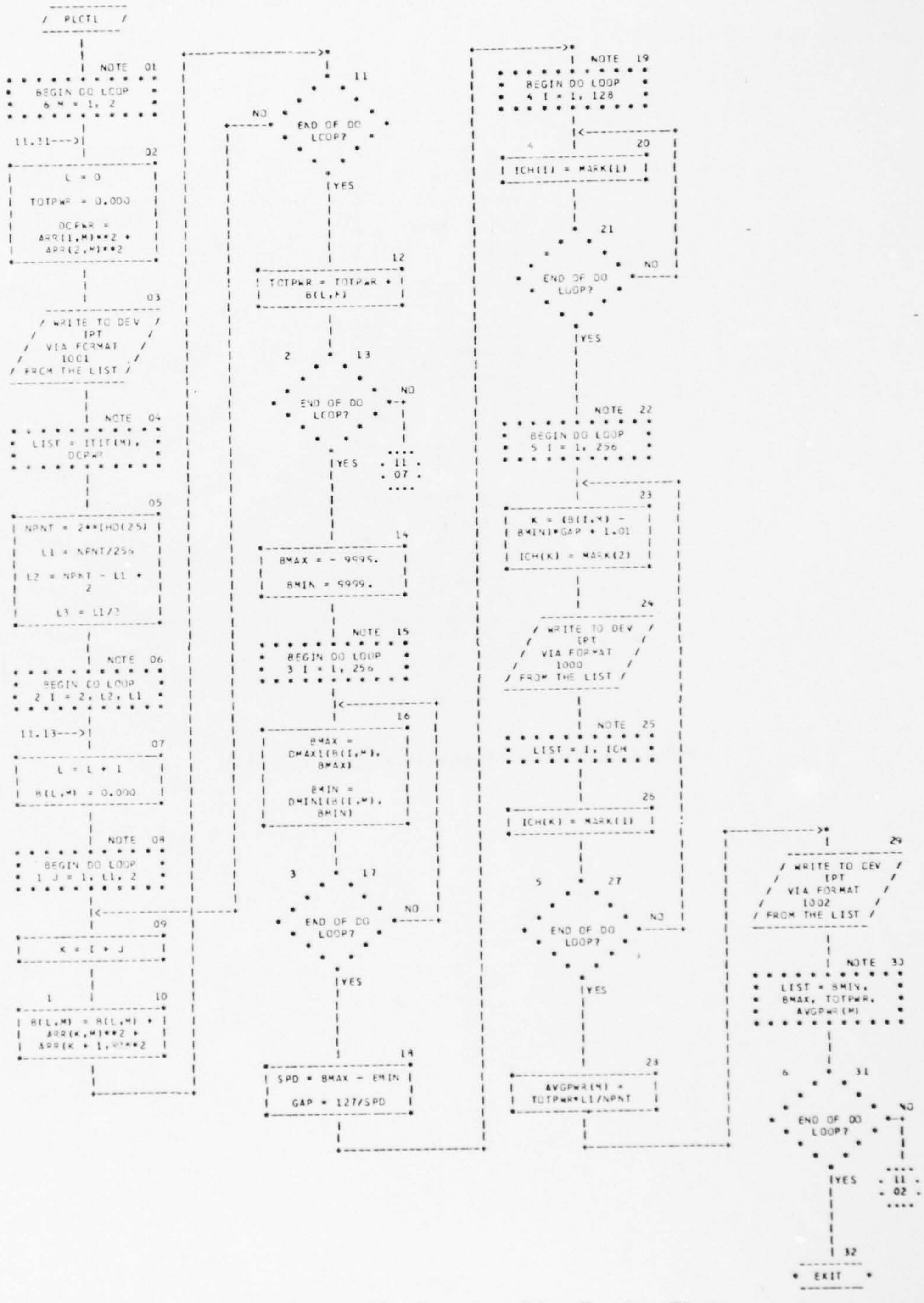
Flow Chart A-50 Frequency Filter I/Q Plotter

```
CHART TITLE - SUBROUTINE SKIPFL

                    ------------
                   /     1     /
                   ------------
                         |
           09.02*-->|
                         |              01
              *--------------------*
              | |       GETREC     H
              | |                  H
              | |                  H
              | |                  H
              | |                  H
              *--------------------*
                         |
                         |
                         |              02
              *--------------------*
              |  COMPUTED GO TO    |
              |     FOR  IRT       |
              *--------------------*
              |  1           9.01  |
              |  1           9.01  |
              |  3           9.04  |
              |  7           9.03  |
              *--------------------*
                         |
                         |
                         |
              IF OUTSIDE THE RANGE
                         |
           09.02--->|
               2         |              03
                 --------------------
                /                    /
               / WRITE TO DEV       /
              /       IPT          /
             /   VIA FORMAT       /
            /      1000          /
            --------------------
                         |
           09.02--->|
               3         | 04
                    ----------
                    *  EXIT  *
                    ----------
```

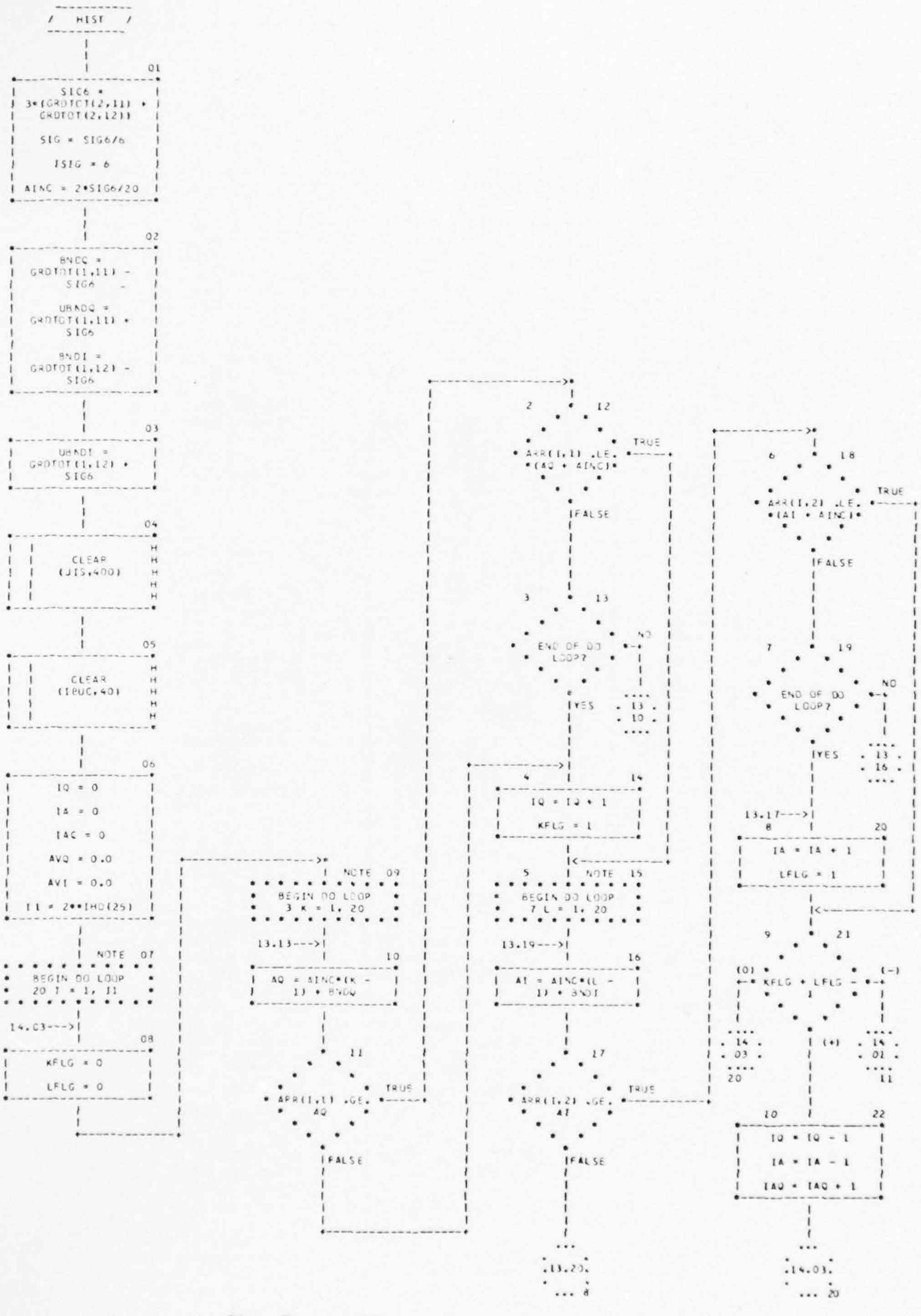
Flow Chart A-51 Frequency Filter File Skip

CHART TITLE - SUBROUTINE PLOT1(AVGPWR)



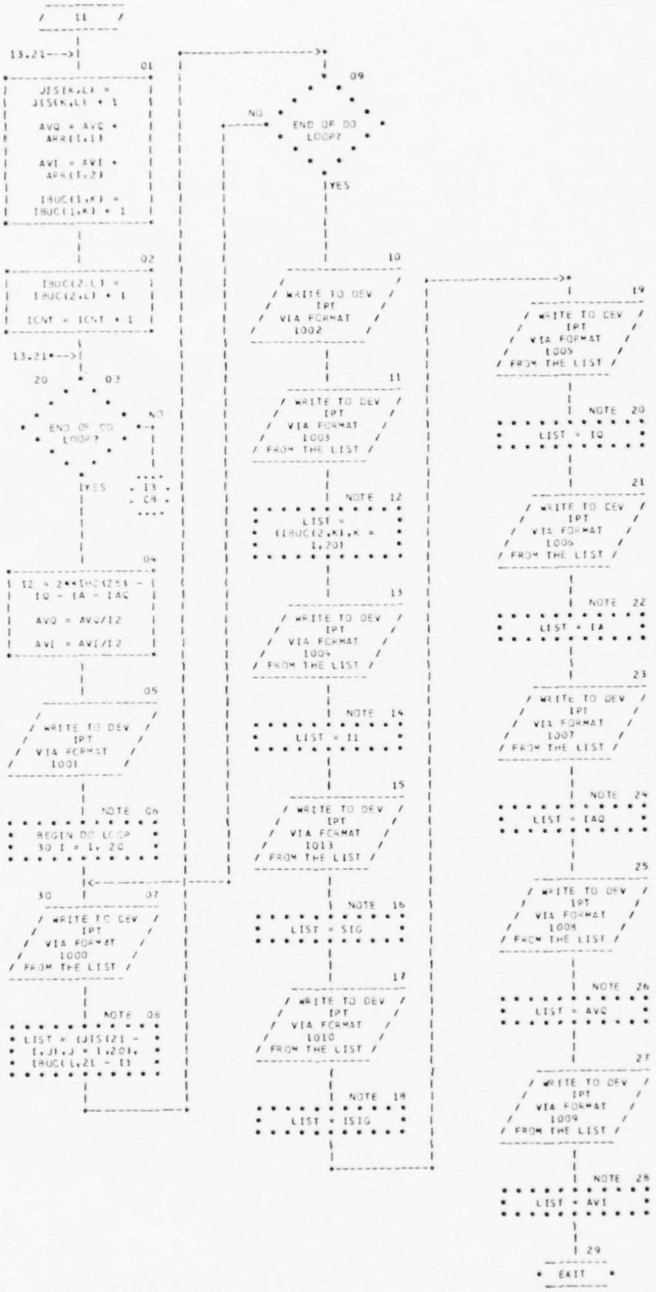
Flow Chart A-52 Frequency Filter Envelope Plotter

CHART TITLE - SUBROUTINE HIST



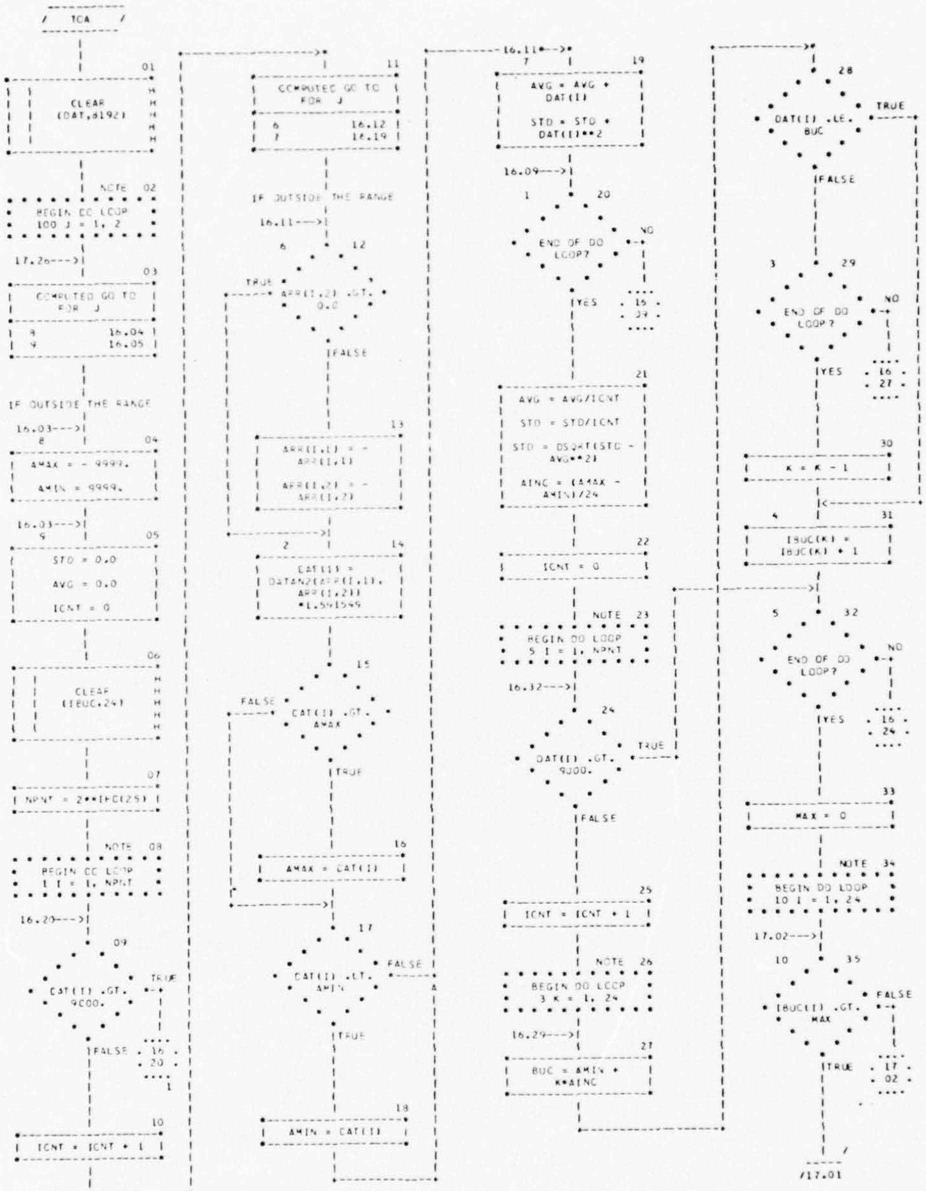
Flow Chart A-53 Frequency Filter Histogram Printer

CHART TITLE - SUBROUTINE HIST


11
13.21--->
01
JIS(K,L) = JIS(K,L) + 1
AVQ = AVQ + ARR(I,1)
AVI = AVI + ARR(I,2)
IBUC(1,K) = IBUC(1,K) + 1
02
IBUC(2,L) = IBUC(2,L) + 1
ICNT = ICNT + 1
13.21*--->
20
03
END OF DO LOOP?
NO
YES
13
C8
04
I2 = 2**IHC(25) - IQ - IA - IAC
AVQ = AVQ/I2
AVI = AVI/I2
05
WRITE TO DEV IPT VIA FORMAT 1001
NOTE 06
BEGIN DO LOOP 30 I = 1, 20
30
07
WRITE TO DEV IPT VIA FORMAT 1000 FROM THE LIST
NOTE 08
LIST = (JIS(21 - I,J),J = 1,20), IBUC(1,21 - I)
09
NO
END OF DO LOOP?
YES
10
WRITE TO DEV IPT VIA FORMAT 1002
11
WRITE TO DEV IPT VIA FORMAT 1003 FROM THE LIST
NOTE 12
LIST = (IBUC(2,K),K = 1,20)
13
WRITE TO DEV IPT VIA FORMAT 1004 FROM THE LIST
NOTE 14
LIST = I1
15
WRITE TO DEV IPT VIA FORMAT 1013 FROM THE LIST
NOTE 16
LIST = SIG
17
WRITE TO DEV IPT VIA FORMAT 1010 FROM THE LIST
NOTE 18
LIST = ISIG
19
WRITE TO DEV IPT VIA FORMAT 1005 FROM THE LIST
NOTE 20
LIST = IQ
21
WRITE TO DEV IPT VIA FORMAT 1006 FROM THE LIST
NOTE 22
LIST = IA
23
WRITE TO DEV IPT VIA FORMAT 1007 FROM THE LIST
NOTE 24
LIST = IAQ
25
WRITE TO DEV IPT VIA FORMAT 1008 FROM THE LIST
NOTE 26
LIST = AVQ
27
WRITE TO DEV IPT VIA FORMAT 1009 FROM THE LIST
NOTE 28
LIST = AVI
29
EXIT

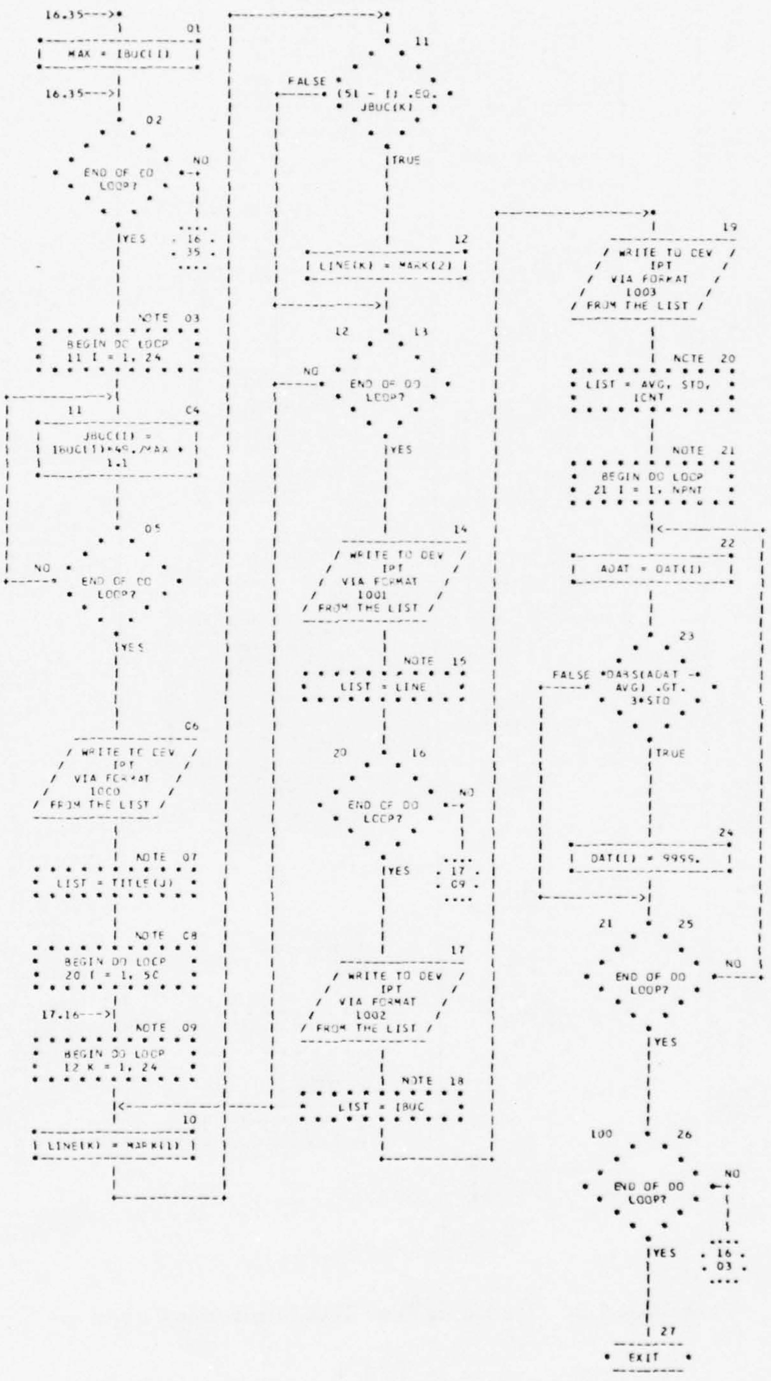
Flow Chart A-53 Frequency Filter Histogram Printer (concluded)

CHART TITLE - SUBROUTINE TOA



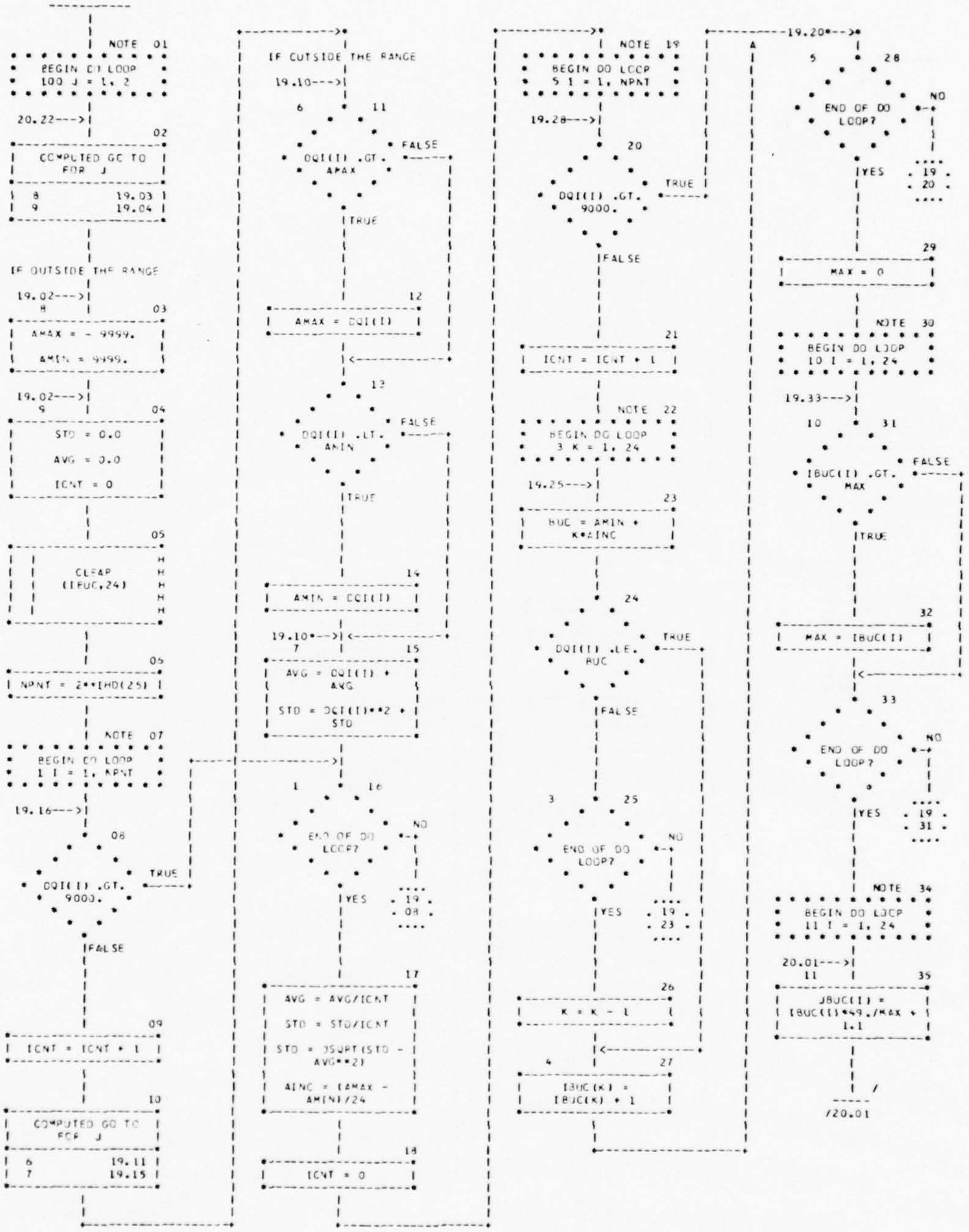
Flow Chart A-54 Frequency Filter TOA Distribution Plotter

CHART TITLE - SUBROUTINE TOA



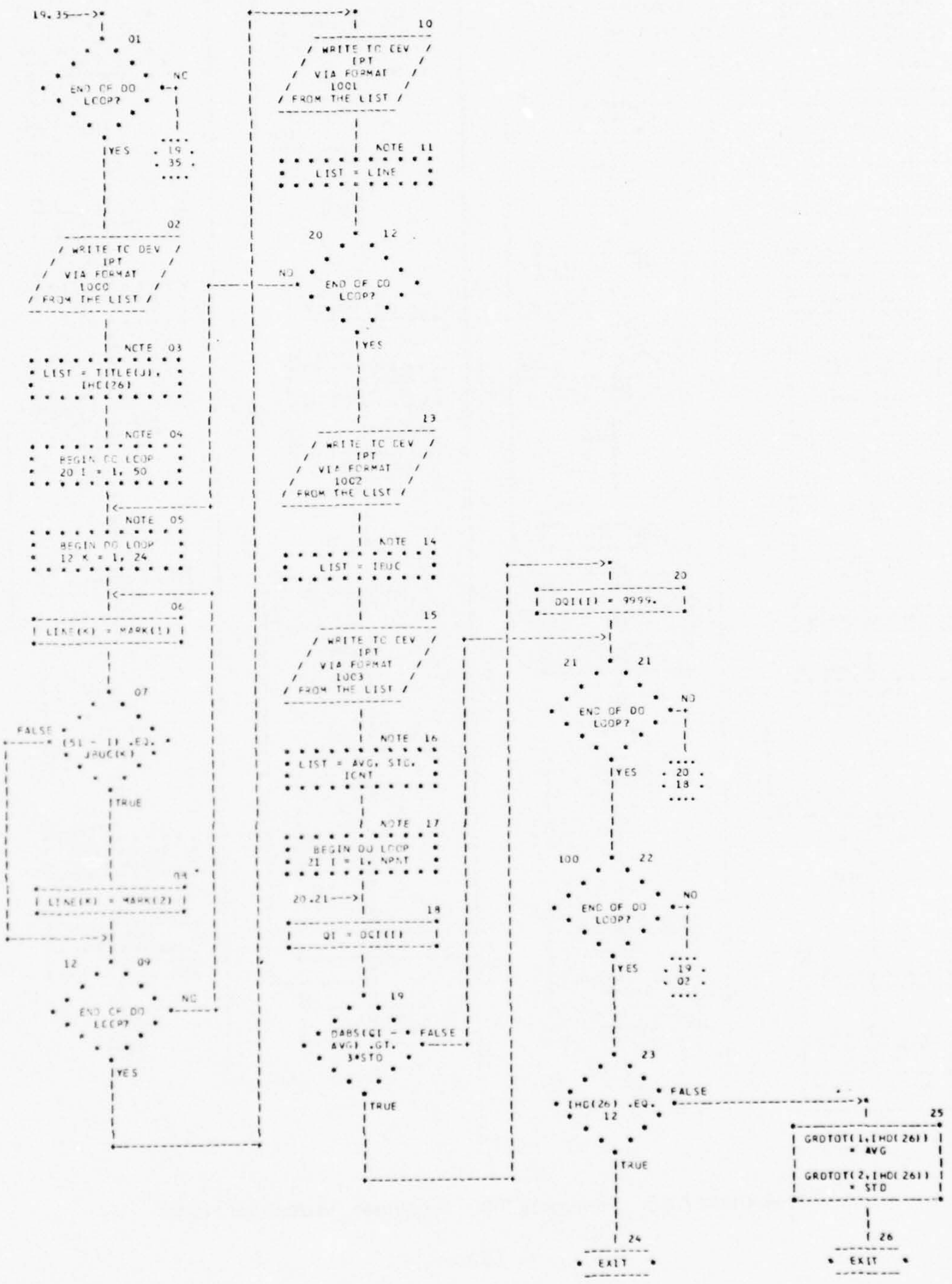
Flow Chart A-54 Frequency Filter TOA Distribution Plotter (concluded)

CHART TITLE - SUBROUTINE AMP



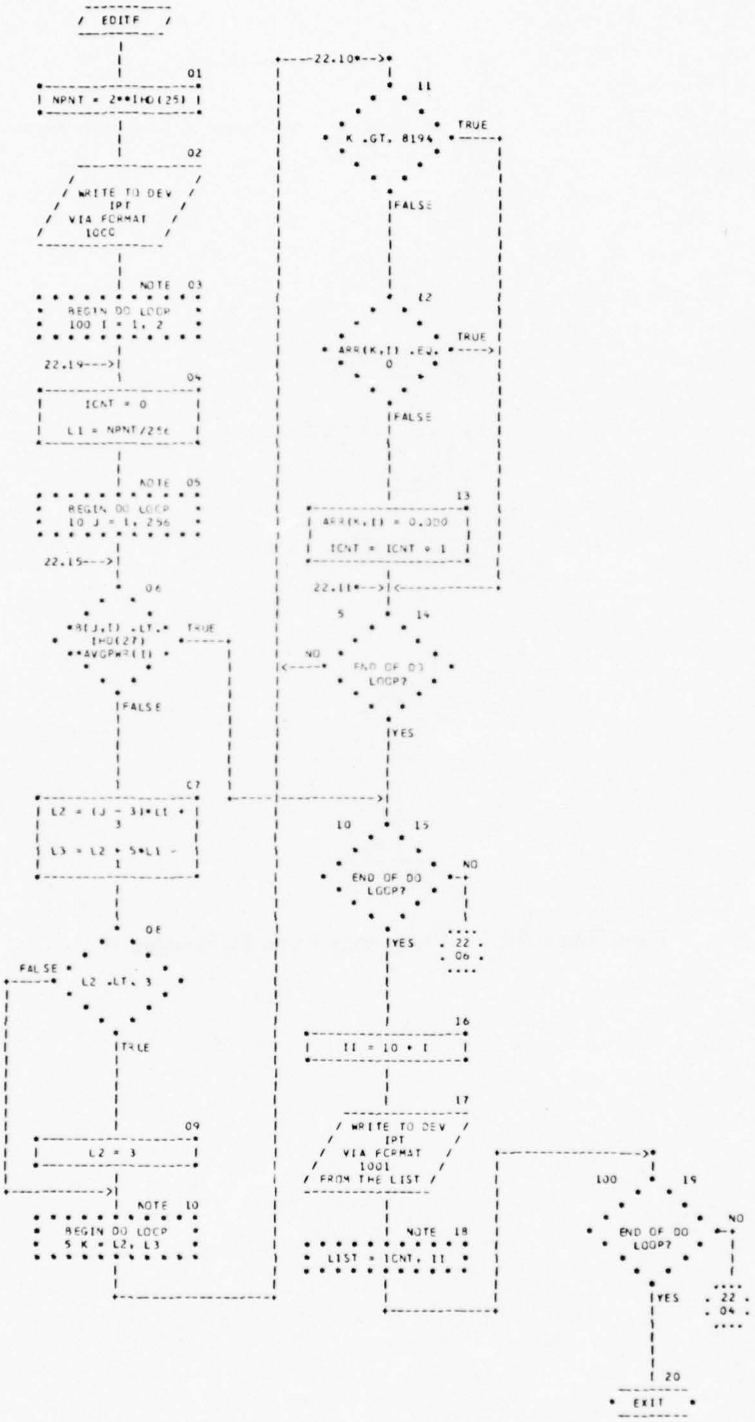
Flow Chart A-55 Frequency Filter Amplitude Distribution Plotter

CHART TITLE - SUBROUTINE AMP



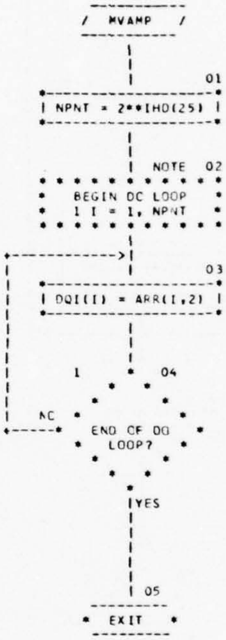
Flow Chart A-55 Frequency Filter Amplitude Distribution Plotter (concluded)

CHART TITLE - SUBROUTINE EDITF(AVGPWR)



Flow Chart A-56 Frequency Filter Notch

CHART TITLE - SUBROUTINE MVAMP



Flow Chart A-57 Frequency Filter Data Selector

```
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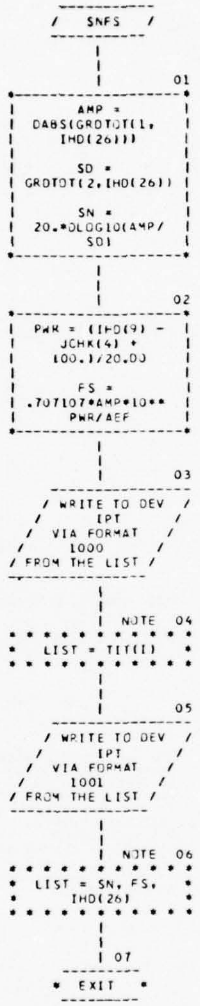
 CHART TITLE - SUBROUTINE  SNFS(JCHK,AEF,I)
```


SNFS
01
AMP = DABS(GRDTOT(1, IHD(26)))
SD = GRDTOT(2,IHD(26))
SN = 20.*DLOG10(AMP/ SD)
02
PWR = (IHD(9) - JCHK(4) + 100.)/20.D0
FS = .707107*AMP*10** PWR/AEF
03
WRITE TO DEV IPT VIA FORMAT 1000 FROM THE LIST
NOTE 04
LIST = TIT(I)
05
WRITE TO DEV IPT VIA FORMAT 1001 FROM THE LIST
NOTE 06
LIST = SN, FS, IHD(26)
07
EXIT

Flow Chart A-58   Frequency Filter Signal-to-Noise and Field Strength Calculator

```
09/28/76        INPUT LISTING                      AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY

ASSEMBLY MODULE     (LIST,NAMSQ)

  CARD NO         ****                        CONTENTS                                   ****

                MACRO
        &NAME   SAVEM &A,&B,&C
        *       EXTENDED SAVE MACRO
        .*      THIS MACRO PROVIDES THE FOLLOWING:
        .*            ISSUES A STANDARD SAVE MACRO  (CONTROL PROGRAM SERVICES)
        .*            GENERATES AN 18-WORD SAVE AREA
        .*            PERFORMS LINKAGE OF HIGHER AND LOWER SAVE AREAS
        .*            INSERTS CURRENT SAVE AREA ADDRESS IN REG 13
        .*            DOES NOT ALTER OTHER REGISTERS
        *       WHEN USING SAVEM, EXIT MAY BE ACCOMPLISHED BY:
        *       L      13,4(13)
        *       RETURN  (N,M)
                LCLC   &XQS
        &XQS    SETC   'XQX'.'&SYSNDX'
        &XQS    DS     0C                     NEED A NAME TO COUNT FROM
        &NAME   SAVE   &A,&B,&C               JUST AS IN C.P.S. MANUAL
                LR     11,13                  HOLD 13 (HIGHER SAVE AREA)
                CNOP   0,4                    ALIGN SAVE AREA
                BAL    13,*-&XQS+76(15)       JUMP PAST SAVE AREA
                DC     18F'0'                 SAVE AREA...13 POINTS HERE NOW
                ST 13,8(11)                   PUT LOWER ADDRESS IN HIGHER SAVE A.
                ST     11,4(13)               AND HIGHER ADDRESS IN LOWER SAVE A.
                L      11,64(11)              RESTORE FROM HIGHER SAVE AREA
                MEND                                                                GET 0000
                SPACE 2                                                             GET 0005
        *       USAGE:                                                              GET 0010
        *                                                                           GET 0015
        *       CALL GETREC, OR                                                     GET 0020
        *       CALL GET1,                                                          GET 0025
        *                                                                           GET 0030
        *       WHERE USER HAS DEFINED A LABELLED COMMON/GETDAT/ERR,DATA-           GET 0035
        *       WHERE ERR IS A FULL WORD AND DATA HAS A LENGTH OF                   GET 0040
        *       AT LEAST 'LRECL' BYTES.                                             GET 0045
                SPACE 2                                                             GET 0050
        GETREC  CSECT                                                               GET 0055
        GET1    EQU    *                                                            GET 0060
                ENTRY GET1                                                          GET 0065
                SPACE 2                                                             GET 0075
                SAVEM (14,12),,*                                                    GET 0080
                LR     10,15                                                        GET 0085
                USING GETREC,10                                                     GET 0090
                L      11,=V(GETDAT)                                                GET 0095
                USING GETDAT,11                                                     GET 0100
                LA     12,DCB                                                       GET 0105
                USING IHADCB,12                                                     GET 0110
                SPACE                                                               GET 0115
                TM     DCBOFLGS,X'10'                                               GET 0120
                BO     GET                    IF DCB OPEN, READ RECORD              GET 0125
                SPACE                                                               GET 0130
                OPEN   (DCB,INPUT)                                                  GET 0135
                TM     DCBOFLGS,X'10'                                               GET 0140
                BZ     NODD                   SET ERROR FLAG TO NO MORE TAPES       GET 0145
                SPACE 2                                                             GET 0150
        GET     EQU    *                                                            GET 0155
                MVC    ERW(4),=XL4'1' INITIALIZE TO GOOD I/O                        GET 0160
        *                                                                           GET 0165
                GET    DCB,INCY                                                     GET 0170
                SPACE 2                                                             GET 0175
        RTN     EQU    *                                                            GET 0180
                L      13,4(13)                                                     GET 0185
                RETURN (14,12),T                                                    GET 0190
                EJECT                                                               GET 0195
        ERROR   EQU    *                                                            GET 0200
                ST     0,ADFSSI             CONTAINS ADDRESS OF STANDARD            GET 0205
        *                                   STATUS INDICATORS AND A DISPLACEMENT    GET 0210
        *                                   VALUE TO REACH THE CCW                  GET 0215
                ST     1,ADFDCB             CONTAINS ADDRESS OF DCB                 GET 0220
                MVC    ERW(4),=XL4'2' SET TO I/O ERROR                              GET 0225
                LR     1,0            PUT IOB ADDRESS INTO R1                       GET 0230
                MVC    SAVIOB(20),0(1)  MOVE INTO LOCAL AREA FOR                    GET 0235
        *                                  REFERENCE IF CALLING PROGRAM TERMINATES GET 0240
        *                                  WITH A DUMP                              GET 0245
                BR     14                   RETURN TO SYSTEM, WHICH WILL            GET 0250
        *                                   RETURN TO STATMENT AFTER GET            GET 0255
                SPACE 2                                                             GET 0260
        EOF     EQU    *                                                            GET 0265
                MVC    ERW(4),=XL4'3' SET TO END OF FILE                            GET 0270
                CLOSE (DCB)                                                         GET 0275
                SPACE 2                                                             GET 0280
        *       CHANGE DDNAME BY INCREMENTING 'INPUT1' TO 'INPUT2' ETC.
                LH     4,=H'0'                                                      GET 0281
                IC     4,DCBDDNAM+6                                                 GET 0282
                AH     4,=H'1'                                                      GET 0283
                CH     4,=H'250'                                                    GET 0284
                BC     4,LESS                                                       GET 0285
                IC     4,DCBDDNAM+5                                                 GET 0286
                AH     4,=H'1'                                                      GET 0287
                STC    4,DCBDDNAM+5                                                 GET 0288
                IC     4,=X'F0'                                                     GET 0289
        LESS    STC    4,DCBDDNAM+6                                                 GET 0300
                B      RTN                                                          GET 0305
                SPACE 2                                                             GET 0310
        NODD    EQU    *                                                            GET 0315
                MVC    ERW(4),=XL4'4' SET TO NO DD CARD                             GET 0320
                B      RTN
                SPACE 2                                                             GET 0321
        *       ENTRY TO CLOSE A FILE AND INCREMENT THE DDNAME.                     GET 0322
        *       SETS UP THE BASE REGISTER SO THAT IT WILL HAVE THE                  GET 0323
        *       SAME VALUE THROUGHOUT THE CSECT. IT THEN PERFORMS                   GET 0324
        *       THE SAME PROCEDURE AS THOUGH AN END-OF-FILE WERE ENCOUNTERED
                SPACE 2
        CFILE   SAVEM (14,12),,*
                ENTRY CFILE
                USING CFILE,15                                                      GET 0328
                L      10,=A(GETREC)                                                GET 0329
                DROP   15                                                           GET 0330
                USING GETREC,10                                                     GET 1330
                L      11,=V(GETDAT)
```

Program Listing A-59   Group Phase Library Raw Data Tape Reader

```
09/28/76        INPUT LISTING                         AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY

 CARD NO        ****                           CONTENTS                                      ****

   109                    LA     12,DCB                                                   GET 1332
   110                    B      EOF                                                      GET 0331
   111                    EJECT
   112          AOFSSI    DC     F'0'                                                     GET 0333
   113          AOFDCB    DC     F'0'                                                     GET 0335
   114          SAVIOB    DC     20X'00'                                                  GET 0340
   115                    SPACE  2                                                        GET 0345
   116          DCB       DCB    DSORG=PS,MACRF=(GM),DDNAME=INPUT01,                     XGET 0350
   117                           EODAD=EOF,SYNAD=ERROR,EROPT=ACC                          GET 0355
   118                    SPACE  2                                                        GET 0360
   119          GETDAT    DSECT                                                           GET 0365
   120          ERW       DS     F                                                        GET 0370
   121          INCY      DS     F                                                        GET 0375
   122                    DCBD   DSORG=(QS),DEVD=(TA)                                     GET 0380
   123                    END                                                             GET 0385
```

Program Listing A-59 Group Phase Library Raw Data Tape Reader (concluded)

```
09/28/76        INPUT LISTING                                AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY

ASSEMBLY MODULE      (LIST,NAMSQ)

 CARD NO          ****                              CONTENTS                                   ****

                  *  FORTRAN CALLABLE ROUTINE TO CONCATENATE TWO FULL WORDS, SHIFT
                  *  LOGICALLY LEFT OR RIGHT A SPECIFIED NUMBER OF PLACES, AND STORE
                  *  LO-ORDER AND HI-ORDER  RESULT BACK IN ORIGINAL WORDS.
                  *  CALLING SEQUENCE:  CALL SHFTL(A,B,C,RC) WHERE A AND B ARE ORIGINAL
                  * TWO WORDS, C IS NUMBER OF SHIFTS AND SIGN BIT + FOR  LEFT SHIFT
                  *  AND - FOR RIGHT SHIFT, AND RC IS RETURN CODE.  RC=16 IF |C| >64.
                  *
                  *
                  SHFTL  CSECT
                         SAVE     (14,12),,*
                         USING    SHFTL,12
                           LR     12,15
                           ST     13,SAVE+4
                           LR     2,13
                           LA     13,SAVE
                         ST       13,8(2)
                           LR     2,1     PARAMETER LIST POINTER
                           LA     10,0          SET RC=0
                  *
                  *  PICK UP FIRST AND SECOND PARAMETERS IN REGS 6 AND 7
                           L      6,0(0,2)     ADDR OF A
                           L      4,0(6)       A
                           L      7,4(2)
                           L      5,0(7)       B
                  *
                  *  PICK UP 3RD PARAMETER AND GET NB OF SHIFTS
                           L      8,8(2)
                           L      9,0(8)       C
                           LPR    9,9               POS VALUE OF C IN R9
                           LTR    9,9  SEE IF NO. SHIFTS = 0
                           BE     EXIT
                           C      9,=F'64'  SEE IF |NB. SHIFTS| > 64
                           BH     GR64   YES
                           TM     0(8),X'80'  IS C NEG
                           BNO     POS
                  LR       SRDL   4,1   SHIFT RT  SINCE C IS NEG
                           BCT    9,LR
                           B      STORE
                  POS      SLDL   4,1   SHIFT LEFT SINCE C POS
                           BCT    9,POS  LOOP FOR ALL
                  *
                  *  STORE RC AND EXIT
                  STORE    ST      4,0(6)   A
                           ST      5,0(7)    B
                  EXIT     L       11,12(2)   ADDR OF RC
                           ST      10,0(11)   STORE RETURN CODE IN RC
                           L       13,SAVE+4
                           RETURN  (14,12)
                  *
                  GR64     LA      10,16
                           B       EXIT
                  *
                  SAVE     DS      18F
                           END SHFTL
```

Program Listing A-60   Group Phase Library Logical Shift Routine

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY

ASSEMBLY MODULE     (LIST,NAMSQ)

 CARD NO         ****                              CONTENTS                              ****

                 *  FORTRAN CALLABLE ROUTINE TO CONCATENATE TWO FULL WORDS, SHIFT
                 *  ARITHMETICALLY LEFT OR RIGHT A SPECIFIED NUMBER OF PLACES, AND STORE
                 *  LO-ORDER AND HI-ORDER  RESULT BACK IN ORIGINAL WORDS.
                 *  CALLING SEQUENCE:  CALL SHFTA(A,B,C,RC) WHERE A AND B ARE ORIGINAL
                 * TWO WORDS, C IS NUMBER OF SHIFTS AND SIGN BIT + FOR  LEFT SHIFT
                 *  AND - FOR RIGHT SHIFT, AND RC IS RETURN CODE.  RC=16 IF |C| >64.
                 *
                 *
                 SHFTA  CSECT
                        SAVE    (14,12),,*
                        USING   SHFTA,12
                          LR    12,15
                          ST    13,SAVE+4
                          LR    2,13
                          LA    13,SAVE
                          ST    13,8(2)
                          LR    2,1    PARAMETER LIST POINTER
                          LA    10,0         SET RC=0
                 *
                 *  PICK UP FIRST AND SECOND PARAMETERS IN REGS 6 AND 7
                          L     6,0(0,2)    ADDR OF A
                          L     4,0(6)      A
                          L     7,4(2)
                          L     5,0(7)      B
                 *
                 *  PICK UP 3RD PARAMETER AND GET NB OF SHIFTS
                          L     8,8(2)
                          L     9,0(8)      C
                          LPR   9,9                POS VALUE OF C IN R9
                          LTR   9,9  SEE IF NO. SHIFTS = 0
                          BE    EXIT
                          C     9,=F'64'  SEE IF |NB. SHIFTS| > 64
                          BH    GR64   YES
                          TM    0(8),X'80'  IS C NEG
                          BNO    POS
                 LR       SRDA  4,1   SHIFT RT  SINCE C IS NEG
                          BCT   9,LR
                          B     STORE
                 POS      SLDA  4,1   SHIFT LEFT SINCE C POS
                          BCT   9,POS  LOOP FOR ALL
                 *
                 *  STORE RC AND EXIT
                 STORE    ST    4,0(6)   A
                          ST    5,0(7)    B
                 EXIT     L     11,12(2)   ADDR OF RC
                          ST    10,0(11)   STORE RETURN CODE IN RC
                          L     13,SAVE+4
                          RETURN  (14,12)
                 *
                 GR64     LA    10,16
                          B     EXIT
                 *
                 SAVE     DS    18F
                          END SHFTA
```

Program Listing A-61   Group Phase Library Arithmetic Shift Routine

```
09/28/76        INPUT LISTING                          AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY

ASSEMBLY MODULE      (LFST.NAMSQ)

  CARD NO       ****                                   CONTENTS                                    ****

                DFFTA    CSECT                                                                DFTA   1
                * DFFTA ONE DIMENSIONAL DOUBLE PRECISION FAST FOURIER TRANSFORM. THIS         DFTA   2
                *        VERSION IS USED WITH FORTRAN IV.                                     DFTA   3
                *        USE:   CALL DFFTA(A,M,KOPT)                                          DFTA   4
                *               A IS DOUBLE PREC. FLOATING POINT INPUT AND OUTPUT ARRAY.      DFTA   5
                *               A IS DIMENSIONED 2**M FOR COMPLEX CALCULATIONS.               DFTA   6
                *               IN THIS CASE A(1) IS FIRST REAL PART, A(2) IS FIRST           DFTA   7
                *               IMAGINARY PART, A(3) IS SECOND REAL PART, A(4) IS SECOND      DFTA   8
                *               IMAGINARY PART ETC. UP TO 2**(M-1) COMPLEX NUMBERS.           DFTA   9
                *               A IS DIMENSIONED 2**M+2 FOR REAL CALCULATIONS.                DFTA  10
                *               IN THIS CASE REAL VALUES OF DATA ARE PUT INTO A(1),....       DFTA  11
                *               A(2**M). COEFFICIENTS A0/2,B0=0,A1,B1,....,(AN/2)/2,          DFTA  12
                *               BN/2=0 MUST BE PUT INTO A(1),....,A(2**M+2) RESPECTIVELY.     DFTA  13
                *               M IS FIXED POINT INTEGER INDICATING NUMBER OF VALUES          DFTA  14
                *               IN A AS IT IS USED ABOVE.                                     DFTA  15
                *               KOPT IS A FIXED POINT INTEGER.                                DFTA  16
                *               IF KOPT=0, INPUT IS REAL DATA. OUTPUT IS COEFFICIENTS.        DFTA  17
                *               IF KOPT=2, INPUT IS COEFFICIENTS. OUTPUT IS REAL DATA.        DFTA  18
                *               IF W=E**(2*PI*I/N), F(J) IS THE COMPLEX DATA OR INVERSE       DFTA  19
                *               COMPLEX FOURIER TRANSFORM, AND C(K) IS THE COMPLEX            DFTA  20
                *               FOURIER TRANSFORM, THEN                                       DFTA  21
                *                     F(J) = SUM(C(K)*W**(J*K)), J=0,1,....,N-1.              DFTA  22
                *               WHERE THE SUMMATION IS FOR K=0,1,....,N-1. AND                DFTA  23
                *                     C(K) = 1/N*SUM(F(J)*W**(-J*K)), K=0,1,....,N-1.         DFTA  24
                *               WHERE THE SUMMATION IS FOR J=0,1,....,N-1.                    DFTA  25
                *               IF KOPT=1, INPUT IS COMPLEX DATA OR INVERSE COMPLEX           DFTA  26
                *               FOURIER TRANSFORM. OUTPUT IS COMPLEX FOURIER TRANSFORM.       DFTA  27
                *               IF KOPT=3, INPUT IS COMPLEX FOURIER TRANSFORM. OUTPUT         DFTA  28
                *               IS INVERSE COMPLEX FOURIER TRANSFORM OR COMPLEX DATA.         DFTA  29
                *               IF M<3, NO COMPUTATION WILL TAKE PLACE.                       DFTA  30
                         USING *,15            USE BRANCH REGISTER AS BASE REGISTER           DFTA  31
                         USING A,2                                                            DFTA  32
                         USING S,3                                                            DFTA  33
                         B     DFFTA1                                                         DFTA  34
                         DC    XL1'05'                                                        DFTA  35
                         DC    C'DFFTA'                                                       DFTA  36
                DFFTA1   SAVE  (14,12)         SAVE REGISTERS IN SAVE AREA                    DFTA  37
                         DROP  15                                                             DFTA  38
                         BALR  10,0                                                           DFTA  39
                         USING *,10            STANDARD PROGRAM BASE REGISTER                 DFTA  40
                         LR    3,13            OLD SAVE AREA ADDRESS                          DFTA  41
                         LA    13,AREA         NEW SAVE AREA ADDRESS                          DFTA  42
                         ST    13,8(0,3)       ADDRESS OF NEW SAVE AREA INTO OLD AREA         DFTA  43
                         ST    3,4(0,13)       ADDRESS OF OLD AREA TO WORD 2 OF NEW AREA      DFTA  44
                         MVC   AD(12),0(1)     PARAMETER ADDRESSES                            DFTA  45
                         MVI   AD+8,X'00'                                                     DFTA  46
                         L     4,AD+4          ADDRESS OF M TO R4                             DFTA  47
                         L     4,0(0,4)        M                                              DFTA  48
                         C     4,=F'2'                                                        DFTA  49
                         BC    13,DFFTA20      EXIT IF M<3                                    DFTA  50
                DFFTA2   L     2,AD            ADDRESS OF A TO R2                             DFTA  51
                         S     2,=F'8'         ADDRESS OF A - ONE WORD                        DFTA  52
                         L     6,AD+8                                                         DFTA  53
                         MVC   KOPT,0(6)       STORE KOPT                                     DFTA  54
                         MVC   DFFTA13,PS      FILL INSTRUCTION FOR + IMAGINARY PART          DFTA  55
                         LA    5,1             1 TO R5                                        DFTA  56
                         SLA   5,3(4)          (2**M)*8 FOR 8 BYTE WORDS TO R5                DFTA  57
                         ST    5,N             STORE NUMBER ELEMENTS IN A ARRAY               DFTA  58
                         LR    6,5                                                            DFTA  59
                         SRA   6,4             N/2 FLOATING POINT FOR FT FACTOR               DFTA  60
                         ST    6,FL+4          NH                                             DFTA  61
                         SLA   6,3             NH FOR 8 BYTE WORDS                            DFTA  62
                         ST    6,NH                                                           DFTA  63
                         SDR   4,4                                                            DFTA  64
                         AD    4,FL                                                           DFTA  65
                         STD   4,FN            FLOATING POINT N/2                             DFTA  66
                         LR    7,6                                                            DFTA  67
                         SRA   7,1                                                            DFTA  68
                         A     7,=F'16'        NQ FOR 8 BYTE WORDS                            DFTA  69
                         ST    7,NQ                                                           DFTA  70
                         C     4,OLDM                                                         DFTA  71
                         L     3,SBA           CURRENT ADDRESS OF S TO R3                     DFTA  72
                         BC    8,DFFTA5        DO NOT GENERATE S STORAGE IF EQUAL             DFTA  73
                         CLC   OLDM,=F'0'                                                     DFTA  74
                         BC    8,DFFTA3        NO STORAGE TO RELEASE IF OLDM=0.               DFTA  75
                         L     0,OLDS                                                         DFTA  76
                         L     1,SBA                                                          DFTA  77
                         A     1,=F'8'         CORRECT S ADDRESS TO RELEASE                   DFTA  78
                         FREEMAIN R,LV=(0),A=(1)                                              DFTA  79
                DFFTA3   ST    4,OLDM          NEW M TO OLDM                                  DFTA  80
                         LR    0,5                                                            DFTA  81
                         SRA   0,2                                                            DFTA  82
                         A     0,=F'8'         N/4+1 - 8 BYTE WORDS - REQUIRED FOR S          DFTA  83
                         ST    0,OLDS                                                         DFTA  84
                         GETMAIN R,LV=(0)                                                     DFTA  85
                         LR    3,1                                                            DFTA  86
                         S     3,=F'8'         S ADDRESS TO R3                                DFTA  87
                         ST    3,SBA                                                          DFTA  88
                         LR    8,7                                                            DFTA  89
                         S     8,=F'8'         L-2 FOR 8 BYTE WORDS                           DFTA  90
                         LD    0,=D'3.1415926535897932E+0'                                    DFTA  91
                         DD    0,FN                                                           DFTA  92
                         STD   0,RI            2*PI/N TO RI                                   DFTA  93
                         LA    1,ARG           ARGUMENT IS RI                                 DFTA  94
                         L     15,VDSIN                                                       DFTA  95
                         BALR  14,15           SIN(RI) TO DS                                  DFTA  96
                         STD   0,DS                                                           DFTA  97
                         LA    1,ARG           ARGUMENT IS RI                                 DFTA  98
                         L     15,VDCOS                                                       DFTA  99
                         BALR  14,15           COS(RI) TO DC                                  DFTA 100
                         STD   0,DC                                                           DFTA 101
                         SDR   0,0             0 TO FR0                                       DFTA 102
                         STD   0,S+8           0 TO S(1)                                      DFTA 103
                         SDR   4,4                                                            DFTA 104
                         LD    0,=D'1.E+0'                                                    DFTA 105
                         LDR   6,0                                                            DFTA 106
                         STD   0,S(8)          1.E0 TO S(NQ-1)                                DFTA 107
                         LD    0,DS                                                           DFTA 108
```

Program Listing A-62   Group Phase Library Fast Fourier Transform

```
 CARD NO     ****                           CONTENTS                                      ****

   109                 STD   0,S+16         SIN(PI) TO S(2)                               DFTA 109
   110                 LA    9,24           INDEX                                         DFTA 110
   111                 LA    14,8           INCREMENT                                     DFTA 111
   112                 LR    15,5                                                         DFTA 112
   113                 SRA   15,3                                                         DFTA 113
   114                 A     15,=F'8'       COMPARAND N/8+1 FOR 8 BYTE WORDS              DFTA 114
   115                 CNOP  0,8            ALIGN LOOP ON DOUBLE-WORD BOUNDARY            DFTA 115
   116       DFFTA4    SR    8,14           L-I TO INDEX REGISTER - 4 BYTE WORDS          DFTA 116
   117                 LD    0,DC                                                         DFTA 117
   118                 MDR   0,6                                                          DFTA 118
   119                 LDR   2,0                                                          DFTA 119
   120                 SDR   2,4                                                          DFTA 120
   121                 LDR   4,6                                                          DFTA 121
   122                 ADR   0,2                                                          DFTA 122
   123                 LDR   6,0                                                          DFTA 123
   124                 MD    0,DS                                                         DFTA 124
   125                 STD   2,S(8)         FR2 TO S(L-I)                                 DFTA 125
   126                 STD   0,S(9)         FR0 TO S(I)                                   DFTA 126
   127                 BXLE  9,14,DFFTA4    SIN(2*PI/N*J), J=0,1,...,N/4 IN S(I),...      DFTA 127
   128       DFFTA5    CLI   KOPT+3,X'02'                                                 DFTA 128
   129                 BC    8,DFFTA17      REAL SYNTHESIS IF KOPT=2                      DFTA 129
   130                 BC    2,DFFTA7       PUT ARRAY IN BIT REVERSED FORM IF KOPT=3      DFTA 130
   131                 LD    4,=D'1.E+0'                                                  DFTA 131
   132                 DD    4,FN           1/N TO FR4                                    DFTA 132
   133                 MVC   DFFTA13,MS     FILL INSTRUCTION FOR - IMAGINARY PART         DFTA 133
   134                 LA    9,8            1 - 8 BYTE WORDS - TO INDEX REGISTER          DFTA 134
   135                 LA    14,16          2 - 8 BYTE WORDS - TO INCREMENT REGISTER      DFTA 135
   136                 L     15,N           N WORDS FOR COMPARAND REGISTER                DFTA 136
   137                 CNOP  0,8            ALIGN LOOP ON DOUBLE-WORD BOUNDARY            DFTA 137
   138       DFFTA6    LD    0,A(9)                                                       DFTA 138
   139                 LD    2,A+8(9)                                                     DFTA 139
   140                 MDR   0,4                                                          DFTA 140
   141                 MDR   2,4                                                          DFTA 141
   142                 STD   0,A(9)                                                       DFTA 142
   143                 STD   2,A+8(9)                                                     DFTA 143
   144                 BXLE  9,14,DFFTA6    MULTIPLY A ARRAY BY 1/N                       DFTA 144
   145       DFFTA7    LA    7,8            1 TO J - 8 BYTE WORDS                         DFTA 145
   146                 LR    1,7            1 TO INDEX I - 8 BYTE WORDS                   DFTA 146
   147                 LA    4,16           2 TO INCREMENT REGISTER - 8 BYTE WORDS        DFTA 147
   148                 L     5,N            N TO R5                                       DFTA 148
   149                 CNOP  0,8            ALIGN LOOP ON DOUBLE-WORD BOUNDARY            DFTA 149
   150       DFFTA8    CR    7,1            COMPARE J TO I                                DFTA 150
   151                 LD    0,A(7)         REAL A(J)                                     DFTA 151
   152                 LD    2,A+8(7)       IMAG A(J)                                     DFTA 152
   153                 LD    4,A(1)         REAL A(I)                                     DFTA 153
   154                 LD    6,A+8(1)       IMAG A(I) - ALL TO REGISTERS                  DFTA 154
   155                 BC    12,DFFTA9      J<=I, DO NOT SWAP                             DFTA 155
   156                 STD   0,A(1)                                                       DFTA 156
   157                 STD   2,A+8(1)                                                     DFTA 157
   158                 STD   4,A(7)         SWAP A(I) AND A(J) - BOTH                     DFTA 158
   159                 STD   6,A+8(7)       REAL AND IMAGINARY PARTS                      DFTA 159
   160       DFFTA9    LR    8,5            N (OR 2*NH) TO K                              DFTA 160
   161       DFFTA10   SRA   8,1            K/2 TO K                                      DFTA 161
   162                 SR    7,8            J-K TO J                                      DFTA 162
   163                 BC    2,DFFTA10      IF J>K, GO BACK                               DFTA 163
   164                 AR    7,8                                                          DFTA 164
   165                 AR    7,8            J-K+K+K OR J+K TO J                           DFTA 165
   166                 BXLE  1,4,DFFTA8     GO BACK IF I<=N                               DFTA 166
   167                 LA    8,16           2 - 8 BYTE WORDS - TO R8                      DFTA 167
   168                 LR    9,8            2 TO I                                        DFTA 168
   169                 L     6,NH           NH TO ID                                      DFTA 169
   170                 LR    7,6                                                          DFTA 170
   171                 SRA   7,1                                                          DFTA 171
   172                 A     7,=F'8'        NH/2+1 TO R7 - 8 BYTE WORDS                   DFTA 172
   173                 ST    7,NH2P1                                                      DFTA 173
   174                 L     15,N           N TO R15                                      DFTA 174
   175                 LR    0,15           N TO IS                                       DFTA 175
   176       DFFTA11   LR    14,9                                                         DFTA 176
   177                 SLA   14,1           2*I TO IST                                    DFTA 177
   178                 L     7,NH2P1        NH/2+1 TO IR                                  DFTA 178
   179                 CR    14,15          COMPARE IST TO N                              DFTA 179
   180                 L     4,=F'8'        1 TO IND - 8 BYTE WORDS                       DFTA 180
   181                 LR    1,4            1 TO J                                        DFTA 181
   182                 BC    2,DFFTA16      FINISHED IF IST>N                             DFTA 182
   183       DFFTA12   LD    0,S(4)         S(IND) TO FR0                                 DFTA 183
   184       DFFTA13   DS    H              LDR 0,0 OR LNDR 0,0 - POSSIPLE SIGN CHANGE DFTA 184
   185                 LNR   11,4           -IND TO R11                                   DFTA 185
   186                 A     11,NQ                                                        DFTA 186
   187                 LD    2,S(11)        S(NQ-IND) TO FR2                              DFTA 187
   188                 BXLE  4,6,DFFTA14    BRANCH IF IND+ID<=IR                          DFTA 188
   189                 SR    7,7            0 TO IR                                       DFTA 189
   190                 SR    4,0            IND-IS (OR 2*ID) TO IND                       DFTA 190
   191                 BC    4,DFFTA14      DO NOT CHANGE SIGN FIRST LOOP                 DFTA 191
   192                 LCDR  2,2            CHANGE SIGN OF S(NQ-IND)                      DFTA 192
   193       DFFTA14   STD   0,SI           STORE IMAGINARY PART OF CURRENT W             DFTA 193
   194                 STD   2,CO           STORE REAL PART OF CURRENT W                  DFTA 194
   195                 LR    5,1            J TO K                                        DFTA 195
   196                 LR    11,1                                                         DFTA 196
   197                 AR    11,9           K+I TO L                                      DFTA 197
   198       DFFTA15   LD    0,CO                                                         DFTA 198
   199                 LD    4,SI                                                         DFTA 199
   200                 LDR   2,0                                                          DFTA 200
   201                 LDR   6,4                                                          DFTA 201
   202                 MD    0,A(11)        CO*A(L) TO FR0                                DFTA 202
   203                 MD    4,A+8(11)      SI*A(L+1) TO FR4                              DFTA 203
   204                 SDR   0,4            CO*A(L)-SI*A(L+1) TO FR0 OR AAR               DFTA 204
   205                 MD    2,A+8(11)      CO*A(L+1) TO FR2                              DFTA 205
   206                 MD    6,A(11)        SI*A(L) TO FR6                                DFTA 206
   207                 ADR   2,6            CO*A(L+1)+SI*A(L) TO FR2 OR AAI               DFTA 207
   208                 LCDR  4,0            -AAR TO FR4                                   DFTA 208
   209                 LCDR  6,2            -AAI TO FR6                                   DFTA 209
   210                 AD    0,A(5)         A(K)+AAR TO FR0                               DFTA 210
   211                 AD    2,A+8(5)       A(K+1)+AAI TO FR2                             DFTA 211
   212                 AD    4,A(5)         A(K)-AAR TO FR4                               DFTA 212
   213                 AD    6,A+8(5)       A(K+1)-AAI TO FR6                             DFTA 213
   214                 STD   0,A(5)         FR0 TO A(K)                                   DFTA 214
   215                 STD   2,A+8(5)       FR2 TO A(K+1)                                 DFTA 215
   216                 STD   4,A(11)        FR4 TO A(L)                                   DFTA 216
   217                 STD   6,A+8(11)      FR6 TO A(L+1)                                 DFTA 217
   218                 AR    11,14          L+IST OR NEXT K+I TO L                        DFTA 218
   219                 BXLE  5,14,DFFTA15   STOP IF K+IST>N                               DFTA 219
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Program Listing A-62 Group Phase Library Fast Fourier Transform (continued)

```
 CARD NO      ****                          CONTENTS                                       ****

   220                BXLE  1,8,DFFTA12     STOP IF J>I                                DFTA 220
   221                LR    9,14            IST TO I                                   DFTA 221
   222                SRA   0,1             IS/2 TO IS                                 DFTA 222
   223                SRA   6,1             ID/2 TO ID                                 DFTA 223
   224                BC    15,DFFTA11                                                 DFTA 224
   225       DFFTA16  TM    KOPT+3,X'01'    IF LOW ORDER BIT IS 1, KOPT = 1 OR 3       DFTA 225
   226                BC    1,DFFTA20       EXIT IF LOW ORDER BIT IS 1                 DFTA 226
   227       DFFTA17  LA    4,16            2 - 8 BYTE WORDS - TO I                    DFTA 227
   228                LA    1,8             1 - 8 BYTE WORDS - TO R1                   DFTA 228
   229                L     7,NQ                                                       DFTA 229
   230                SR    7,4             NQ-I TO R7                                 DFTA 230
   231                LA    9,24            3 - 8 BYTE WORDS - TO INITIAL K            DFTA 231
   232                LR    8,4             2 - 8 BYTE WORDS                           DFTA 232
   233                A     8,N                                                        DFTA 233
   234                SR    8,9             N-K+2 TO INITIAL J                         DFTA 234
   235                LR    14,4            2 - 8 BYTE WORDS - TO INCREMENT REGISTER   DFTA 235
   236                L     15,NH                                                      DFTA 236
   237                SR    15,1            NH-1 TO COMPARAND REGISTER                 DFTA 237
   238       DFFTA18  LD    0,A(9)          A(K) TO FR0                                DFTA 238
   239                LD    2,A+8(9)        A(K+1) TO FR2                              DFTA 239
   240                LD    4,A+8(8)        A(J+1) TO FR4                              DFTA 240
   241                LD    6,A(8)          A(J) TO FR6                                DFTA 241
   242                AD    0,A(8)          A(K)+A(J) TO AAR                           DFTA 242
   243                SD    2,A+8(8)        A(K+1)-A(J+1) TO AAI                       DFTA 243
   244                AD    4,A+8(9)        A(J+1)+A(K+1) TO ABR                       DFTA 244
   245                SD    6,A(9)          A(J)-A(K) TO ABI                           DFTA 245
   246                STD   0,A(8)          STORE AAR                                  DFTA 246
   247                STD   2,A+8(8)        STORE AAI                                  DFTA 247
   248                LDR   0,4             ABR TO FR0                                 DFTA 248
   249                LDR   2,6             ABI TO FR2                                 DFTA 249
   250                MD    0,S(7)          ABR*CO                                     DFTA 250
   251                MD    2,S(7)          ABI*CO                                     DFTA 251
   252                MD    4,S(4)          ABR*SI                                     DFTA 252
   253                MD    6,S(4)          ABI*SI                                     DFTA 253
   254                AR    4,1             I+1 TO I                                   DFTA 254
   255                SR    7,1             NQ-I TO R7                                 DFTA 255
   256                ADR   0,6             ABR*CO+ABI*SI TO AW                        DFTA 256
   257                SDR   4,2             ABR*SI-ABI*CO TO ABI                       DFTA 257
   258                LCDR  2,0             -AW TO FR2                                 DFTA 258
   259                LDR   6,4             ABI TO FR6                                 DFTA 259
   260                AD    0,A(8)          AAR+AW                                     DFTA 260
   261                AD    2,A(8)          AAR-AW                                     DFTA 261
   262                SD    4,A+8(8)        -AAI+ABI                                   DFTA 262
   263                AD    6,A+8(8)        AAI+ABI                                    DFTA 263
   264                HDR   0,0                                                        DFTA 264
   265                HDR   2,2                                                        DFTA 265
   266                HDR   4,4                                                        DFTA 266
   267                HDR   6,6                                                        DFTA 267
   268                STD   0,A(9)          .5*(AAR+AW) TO A(K)                        DFTA 268
   269                STD   2,A(8)          .5*(AAR-AW) TO A(J)                        DFTA 269
   270                STD   4,A+8(9)        .5*(-AAI+ABI) TO A(K+1)                    DFTA 270
   271                STD   6,A+8(8)        .5*(AAI+ABI) TO A(J+1)                     DFTA 271
   272                SR    8,14            J-2 TO J                                   DFTA 272
   273                BXLE  9,14,DFFTA18    STOP IF K>(NH-1)                           DFTA 273
   274                LD    0,A+8           A(1) TO AW                                 DFTA 274
   275                LDR   2,0                                                        DFTA 275
   276                A     1,N             N+1 TO INDEX REGISTER                      DFTA 276
   277                CLI   KOPT+3,X'02'                                               DFTA 277
   278                BC    6,DFFTA19       BRANCH IF KOPT ¬=2                         DFTA 278
   279                AD    0,A(1)          KOPT=2                                     DFTA 279
   280                STD   0,A+8           AW+A(N+1) TO A(1)                          DFTA 280
   281                SD    2,A(1)                                                     DFTA 281
   282                STD   2,A+16          AW-A(N+1) TO A(2)                          DFTA 282
   283                MVI   KOPT+3,X'03'    CHANGE OPTION TO 3                         DFTA 283
   284                BC    15,DFFTA7       GO TO BIT REVERSAL SECTION                 DFTA 284
   285       DFFTA19  AD    0,A+16                                                     DFTA 285
   286                SD    2,A+16                                                     DFTA 286
   287                HDR   0,0                                                        DFTA 287
   288                HDR   2,2                                                        DFTA 288
   289                SDR   4,4                                                        DFTA 289
   290                STD   0,A+8           .5*(AW+A(2)) TO A(1)                       DFTA 290
   291                STD   2,A(1)          .5*(AW-A(2)) TO A(N+1)                     DFTA 291
   292                STD   4,A+16          0 TO A(2)                                  DFTA 292
   293                STD   4,A+8(1)        0 TO A(N+2)                                DFTA 293
   294       DFFTA20  L     13,AREA+4       OLD SAVE AREA ADDRESS                      DFTA 294
   295                LM    14,12,12(13)    RESTORE REGISTER CONTENTS                  DFTA 295
   296                MVI   12(13),X'FF'                                               DFTA 296
   297                BCR   15,14           RETURN                                     DFTA 297
   298       A        DSECT                                                            DFTA 298
   299       S        DSECT                                                            DFTA 299
   300       DFFTA    CSECT                                                            DFTA 300
   301       FN       DS    D                                                          DFTA 301
   302       RI       DS    D                                                          DFTA 302
   303       DS       DS    D                                                          DFTA 303
   304       DC       DS    D                                                          DFTA 304
   305       SI       DS    D                                                          DFTA 305
   306       CO       DS    D                                                          DFTA 306
   307       FL       DC    X'4E00000000000000'                                        DFTA 307
   308       AD       DS    3F                                                         DFTA 308
   309       OLDM     DC    F'0'                                                       DFTA 309
   310       OLDS     DS    F                                                          DFTA 310
   311       N        DS    F                                                          DFTA 311
   312       NH       DS    F                                                          DFTA 312
   313       NQ       DS    F                                                          DFTA 313
   314       NH2P1    DS    F                                                          DFTA 314
   315       SBA      DS    F                                                          DFTA 315
   316       KOPT     DS    F                                                          DFTA 316
   317       AREA     DS    18F                                                        DFTA 317
   318       ARG      DC    X'80'                                                      DFTA 318
   319                DC    AL3(RI)                                                    DFTA 319
   320       PS       LDR   0,0             INSTRUCTION FOR + IMAGINARY PART           DFTA 320
   321       MS       LNDR  0,0             INSTRUCTION FOR - IMAGINARY PART           DFTA 321
   322       VDSIN    DC    V(DSIN)                                                    DFTA 322
   323       VDCOS    DC    V(DCOS)                                                    DFTA 323
   324                END                                                              DFTA 324
```

Program Listing A-62   Group Phase Library Fast Fourier Transform (concluded)

```
09/28/76        INPUT LISTING                         AUTOFLOW CHART SET - LORAN     GROUP PHASE LIBRARY

FORTRAN MODULE      (LIST,NAMS2)

 CARD NC       ****                           CONTENTS                              ****

      SUBROUTINE PRNTTL(IHD,IPT)
      DOUBLE PRECISION A(6,8)
      DIMENSION IHD(40)
      WRITE(IPT,2000)
      WRITE(IPT,1006)
      WRITE(IPT,1007)
      WRITE(IPT,1008)
      WRITE(IPT,1009)
      WRITE(IPT,1010)
      WRITE(IPT,1011)
      WRITE(IPT,2001)
      WRITE(IPT,1012)
      WRITE(IPT,1013)
      WRITE(IPT,1014)
      WRITE(IPT,1015)
      WRITE(IPT,1016)
      WRITE(IPT,1017)
      WRITE(IPT,2001)
      WRITE(IPT,1018)
      WRITE(IPT,1019)
      WRITE(IPT,1020)
      WRITE(IPT,1021)
      WRITE(IPT,1022)
      WRITE(IPT,1023)
      WRITE(IPT,2001)
      CALL DATE(IHD(1),ID,IM)
      IHD(22)=ID
      IHD(23)=IM
      CALL DCTDB(A,IM,ID,IHD(2))
      DO 3 K=1,6
    3 WRITE(IPT,2002)(A(K,J),J=1,8)
      WRITE(IPT,2001)
      WRITE(IPT,1000)
      WRITE(IPT,1001)
      WRITE(IPT,1002)
      WRITE(IPT,1003)
      WRITE(IPT,1004)
      WRITE(IPT,1005)
      RETURN
 1000 FORMAT(32X,'JJ',4X,'HH',4X,'HH',4X,'UU',4X,'UU',9X,'//',5X,
     1'AAAAAA',5X,'PPPPPPP',5X,'LL')
 1001 FORMAT(32X,'JJ',4X,'HH',4X,'HH',4X,'UU',4X,'UU',8X,'//',5X,
     1'AA',4X,'AA',4X,'PP',4X,'PP',4X,'LL')
 1002 FORMAT(32X,'JJ',4X,'HHHHHHHH',4X,'UU',4X,'UU',7X,'//',6X,
     1'AAAAAAAA',4X,'PPPPPPP',5X,'LL')
 1003 FORMAT(32X,'JJ',4X,'HH',4X,'HH',4X,'UU',4X,'UU',6X,'//',7X,
     1'AA',4X,'AA',4X,'PP',10X,'LL')
 1004 FORMAT(26X,'JJ',4X,'JJ',4X,'HH',4X,'HH',4X,'UU',4X,'UU',5X,'//',
     18X,'AA',4X,'AA',4X,'PP',10X,'LL')
 1005 FORMAT(27X,'JJJJJJ',3X,'HH',4X,'HH',5X,'UUUUUU',5X,'//',9X,
     1'AA',4X,'AA',4X,'PP',10X,'LLLLLLLL')
 1006 FORMAT(37X,'LL',11X,'OOOOOO',5X,'RRRRRRR',6X,'AAAAAA',5X,'NN',4X,
     1'NN')
 1007 FORMAT(37X,'LL',10X,'OO',4X,'OO',4X,'RR',4X,'RR',4X,'AA',4X,'AA',
     14X,'NNN',3X,'NN')
 1008 FORMAT(37X,'LL',10X,'OO',4X,'OO',4X,'RRRRRRR',5X,'AAAAAAAA',4X,
     1'NN',1X,'N',2X,'NN')
 1009 FORMAT(37X,'LL'10X,'OO',4X,'OO',4X,'RR',2X,'RR',6X,'AA',4X,'AA',
     14X,'NN',2X,'N',1X,'NN')
 1010 FORMAT(37X,'LL',10X,'OO',4X,'OO',4X,'RR',3X,'RR',5X,'AA',4X,'AA',
     14X,'NN',3X,'NNN')
 1011 FORMAT(37X,'LLLLLLLL',5X,'OOOOOO',5X,'RR',4X,'RR',4X,'AA',4X,'AA',
     14X,'NN',4X,'NN')
 1012 FORMAT(32X,'SSSSSS',6X,'IIIIII',6X,'GGGGGG',5X,'NN',4X,'NN',5X,
     1'AAAAAA',5X,'LL')
 1013 FORMAT(31X,'SS',5X,'S',7X,'II',7X,'GG',5X,'G',4X,'NNN',3X,'NN',
     14X,'AA',4X,'AA',4X,'LL')
 1014 FORMAT(32X,'SSSSSS',8X,'II',7X,'GG',10X,'NN',1X,'N',2X,'NN',4X,
     1'AAAAAAAA',4X,'LL')
 1015 FORMAT(37X,'SS',7X,'II',7X,'GG',3X,'GGG',4X,'NN',2X,'N',1X,'NN'
     14X,'AA',4X,'AA',4X,'LL')
 1015 FORMAT(31X,'SS',4X,'SS',7X,'II',7X,'GG',4X,'GG',4X,'NN',3X,'NNN',
     14X,'AA',4X,'AA',4X,'LL')
 1017 FORMAT(32X,'SSSSSS',6X,'IIIIII',6X,'GGGGGG',5X,'NN',4X,'NN',4X,
     1'AA',4X,'AA',4X,'LLLLLLLL')
 1018 FORMAT(1X,'EEEEEEEE',4X,'NN',4X,'NN',4X,'VV',4X,'VV',5X,'IIIIII',
     15X,'RRRRRRR',6X,'OOOOOO',5X,   'NN',4X,'NN',4X,'MM',4X,'MM',4X,
     2'EEEEEEEE',4X,'NN',4X,'NN',4X,'TTTTTTTT')
 1019 FORMAT(1X,'EE',10X,'NNN',3X,'NN',4X,'VV',4X,'VV',7X,'II',7X,'RR',
     14X,'RR',4X,'OO',4X,'OO',4X,'NNN' ,3X,'NN',4X,'MMM',2X,'MMM',4X,
     1'EE',10X,
     2'NNN',3X,'NN',7X,'TT')
 1020 FORMAT(1X,'EEEEEE',6X,'NN',1X,'N',2X,'NN',4X,'VV',4X,'VV',7X,'II',
     17X,'RRRRRRR',5X,'OO',4X,'OO',4X,'NN',1X,'N',2X,'NN',4X,'MM',1X,
     1'MM',
     21X,'MM',4X,'EEEEEE',6X,'NN',1X,'N',2X,'NN',7X,'TT')
 1021 FORMAT(1X,'EE',10X,'NN',2X,'N',1X,'NN',5X,'VV',2X,'VV',8X,'II',
     17X,'RR',2X,'RR',6X,'OO',4X,'OO',4X,'NN',2X,'N',1X,'NN',4X,'MM',
     14X,'MM',
     24X,'EE',10X,'NN',2X,'N',1X,'NN',7X,'TT')
 1022 FORMAT(1X,'EE',10X,'NN',3X,'NNN',6X,'VVVV',9X,'II',7X,'RR',3X,
     1'RR',5X,'OO',4X,'OO',4X,'NN',3X,'NNN',4X,'MM',4X,'MM',4X,'EE',10X,
     1'NN',
     23X,'NNN',7X,'TT')
 1023 FORMAT(1X,'EEEEEEEE',4X,'NN',4X,'NN',7X,'VV',8X,'IIIIII',5X,'RR',
     14X,'RR',5X,'OOOOOO',5X,'NN',4X,'NN',4X,'MM',4X,'MM',4X,
     2'EEEEEEEE',4X,'NN',4X,'NN',7X,'TT')
 2000 FORMAT(1H1,/////)
 2001 FORMAT(//)
 2002 FORMAT(15X,8(4X,A8))
      END
```

Program Listing A-63   Group Phase Library Title Page Printer

```
09/28/76          INPUT LISTING                              AUTOFLOW CHART SET - LORAN     GROUP PHASE LIBRARY

FORTRAN MODULE         (LIST,NAMSQ)
                                                                                                ****
  CARD NO          ****                            CONTENTS

      1                    SUBROUTINE DATE(I,ID,IM)
      2                    DIMENSION MO(12)
      3                    DATA MO/31,60,91,121,152,182,213,244,274,305,335,366/
      4             C      DAY NUMBERS ARE SET FOR LEAP YEAR
      5                    IPT=6
      6                    DO 1 J=1,12
      7                    IF(I.GT.MO(J)) GO TO 1
      8                    IM=J
      9                    ID=I
     10                    IF(J.EQ.1) GO TO 2
     11                    ID=I-MO(J-1)
     12                    GO TO 2
     13                  1 CONTINUE
     14                  2 RETURN
     15                    END
```

Program Listing A-64   Group Phase Library Date Converter

CHART TITLE - SUBROUTINE DDTOB(A,IM,ID,IY)

```
09/28/76        INPUT LISTING                         AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY

FORTRAN MODULE      (LIST,NAMSQ)

 CARD NO        ****                        CONTENTS                              ****

              SUBROUTINE DDTOB(A,IM,ID,IY)
              DOUBLE PRECISION A,B,C,D
              DIMENSION A(6,8),B(6,11),C(54),D(12)
              EQUIVALENCE (B(1,1),C(1)),(B(1,10),D(1))
              DATA C/' 000000 ','00    00','00    00','00    00','03    00',
             1' 000000 ','   111  ',' 1 11   ','   11   ','   11   ','   11   ',
             2' 1111111',' 22222 ','22    22','    22  ','  22    ','22      ',
             3'22222222',' 333333 ','33    33','    3333','      33','33    33',
             4' 333333 ','     444','  44 44',' 44   44','44444444','      44',
             5'      44','55555555','55      ','5555555 ','      55','55    55',
             6' 555555 ',' 666666 ','66      6','6666666 ','66    66','66    66',
             7' 666666 ','77777777','     77 ','    77  ','  77    ','  77    ',
             8' 77     ',' 888888 ','88    88',' 888888 ','88    88','88    88',
             9' 888888 '/
              DATA D/' 999999 ','99    99',' 9999999','      99','99    99',
             1' 999999 ','      //','    //  ','   //   ','  //    ','  //    ',
             2' //     '/
              K=IM/10+1
              DO 1 I=1,6
            1 A(I,1)=B(I,K)
              K=IM-10*(K-1)+1
              DO 2 I=1,6
            2 A(I,2)=B(I,K)
              DO 3 I=1,6
              A(I,6)=B(I,11)
            3 A(I,3)=B(I,11)
              K=ID/10+1
              DO 4 I=1,6
            4 A(I,4)=B(I,K)
              K=ID-10*(K-1)+1
              DO 5 I=1,6
            5 A(I,5)=B(I,K)
              DO 6 I=1,6
            6 A(I,7)=B(I,8)
              K=IY+1
              DO 7 I=1,6
            7 A(I,8)=B(I,K)
              RETURN
              END
```

Program Listing A-65   Group Phase Library Date Formatter

```
09/28/76          INPUT LISTING                             AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO       ****                              CONTENTS                                 ****

                      SUBROUTINE BCDTB(IW,ICN,NC,IARR,J,K)
                      DIMENSION IARR(J)
                      IPT=6
                      IC=ICN
                      N=NC
                      K=0
                      IBND=IC+N-1
                      IF((J-IW)*8.LT.IBND-8) GO TO 900
                      NW=(IBND+7)/8
                      DO 1 I=1,NW
                      L=(IC-1)*4
                      I1=0
                      I2=IARR(IW+I-1)
                      CALL SHFTL(I1,I2,L,M)
                      ICF=IBND
                      IF(ICF.GT.8) ICF=8
                      DO 2 L=IC,ICF
                      I1=0
                      CALL SHFTL(I1,I2,4,M)
                      K=K*10+I1
                    2 CONTINUE
                      N=N-ICF+IC-1
                      IBND=N
                      IC=1
                    1 CONTINUE
                      RETURN
                  900 WRITE(IPT,1000)
                      RETURN
                 1000 FORMAT('CHAR REQUEST EXCEEDS ARRAY SIZE')
                      END
```

Program Listing A-66 Group Phase Library BCD to Binary Converter

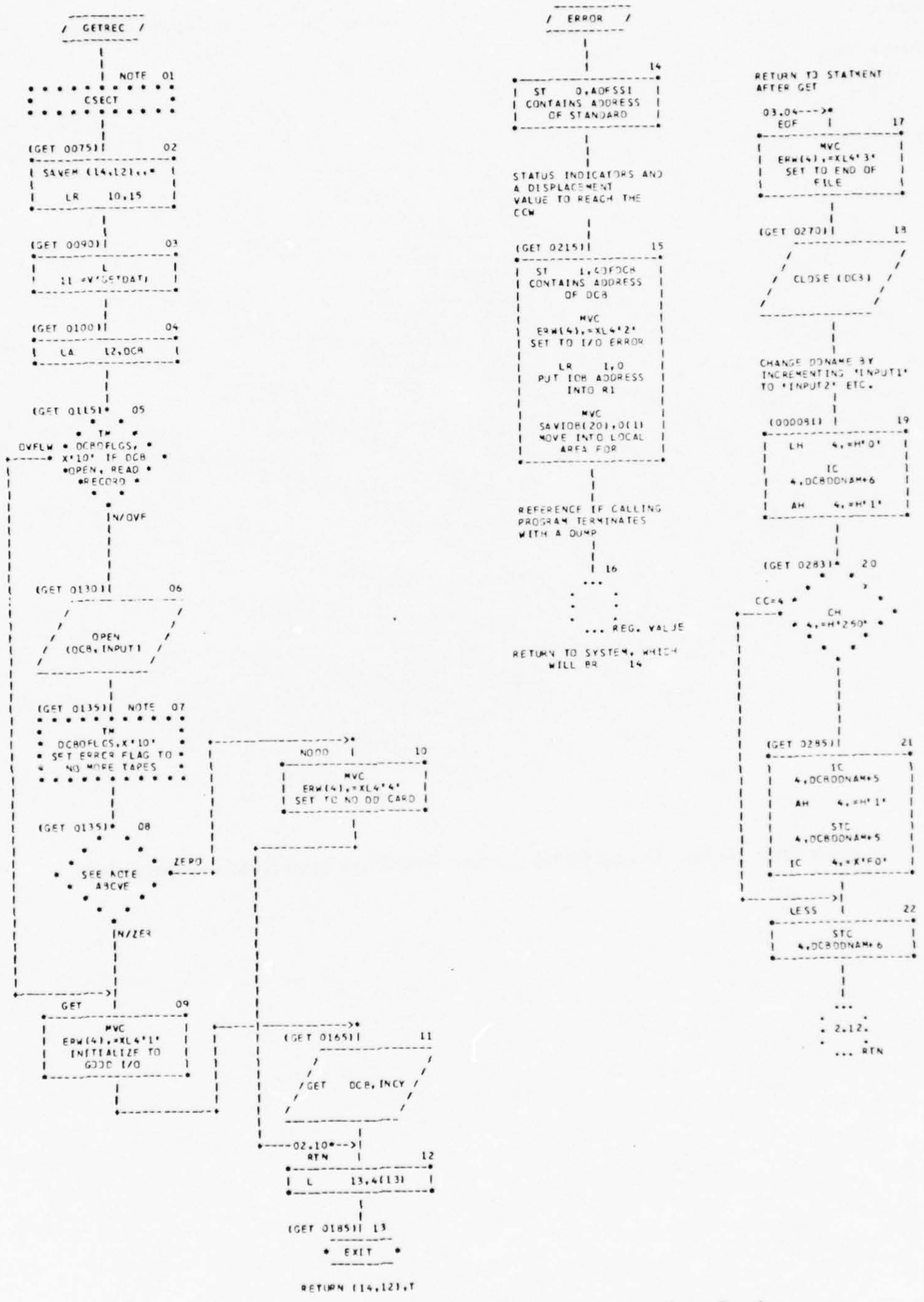
```
09/28/76          INPUT LISTING                             AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY

FORTRAN MODULE       (LIST,NAMSQ)

  CARD NO       ****                              CONTENTS                                 ****

                      SUBROUTINE CLEAR(X,N)
                      DIMENSION X(N)
                      DO 1 I=1,N
                    1 X(I)=0.0
                      RETURN
                      END
```

Program Listing A-67 Group Phase Library Array Reset



Flow Chart A-59 Group Phase Library Raw Data Tape Reader

```
09/28/76                              AUTOFLOW CHART SET - LORAN    GROUP PHASE LIBRARY              PAGE  03

CHART TITLE -

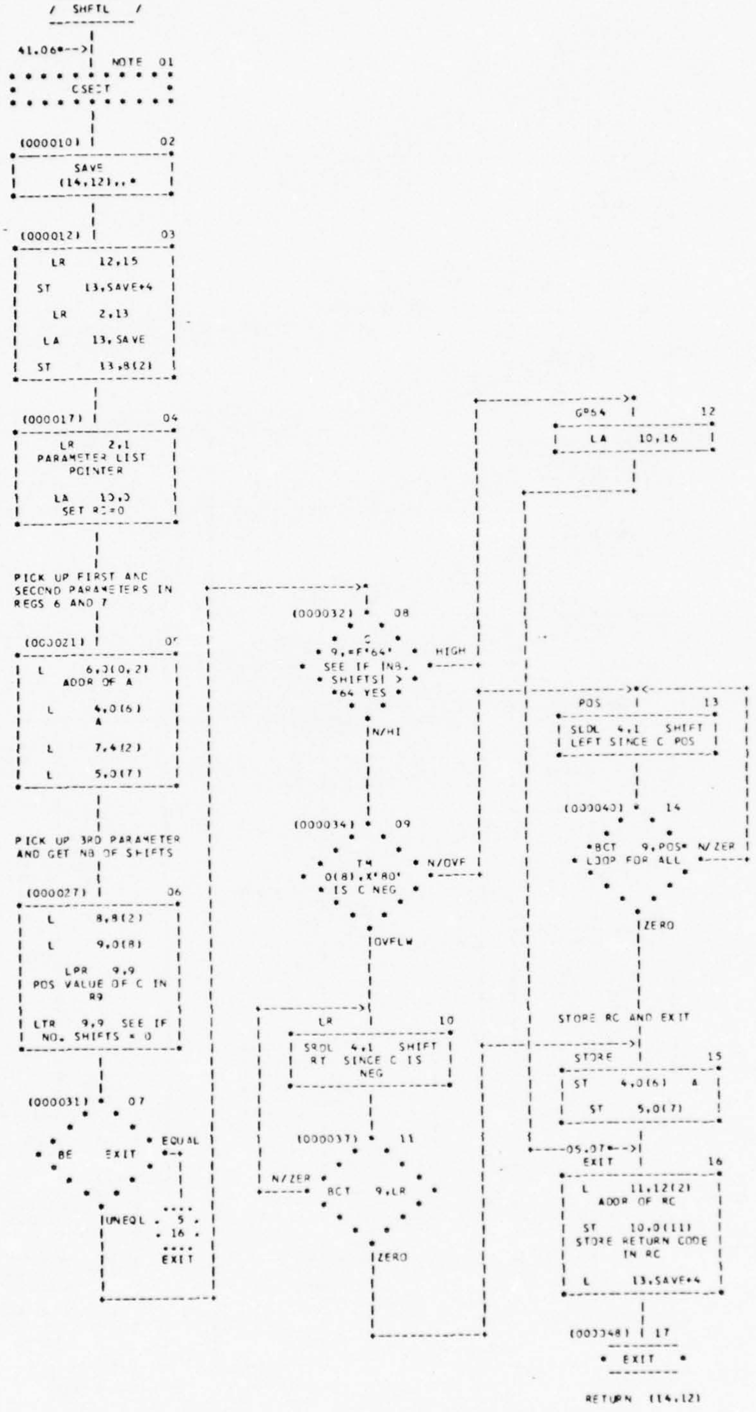



                                  ENTRY TO CLOSE A FILE
                                  AND INCREMENT THE
                                  DDNAME.
                                  SETS UP THE BASE
                                  REGISTER SO THAT IT
                                  WILL HAVE THE
                                  SAME VALUE THROUGHOUT
                                  THE CSECT. IT THEN
                                  PERFORMS
                                  THE SAME PROCEDURE AS
                                  THOUGH AN END-OF-FILE
                                  WERE ENCOUNTERED

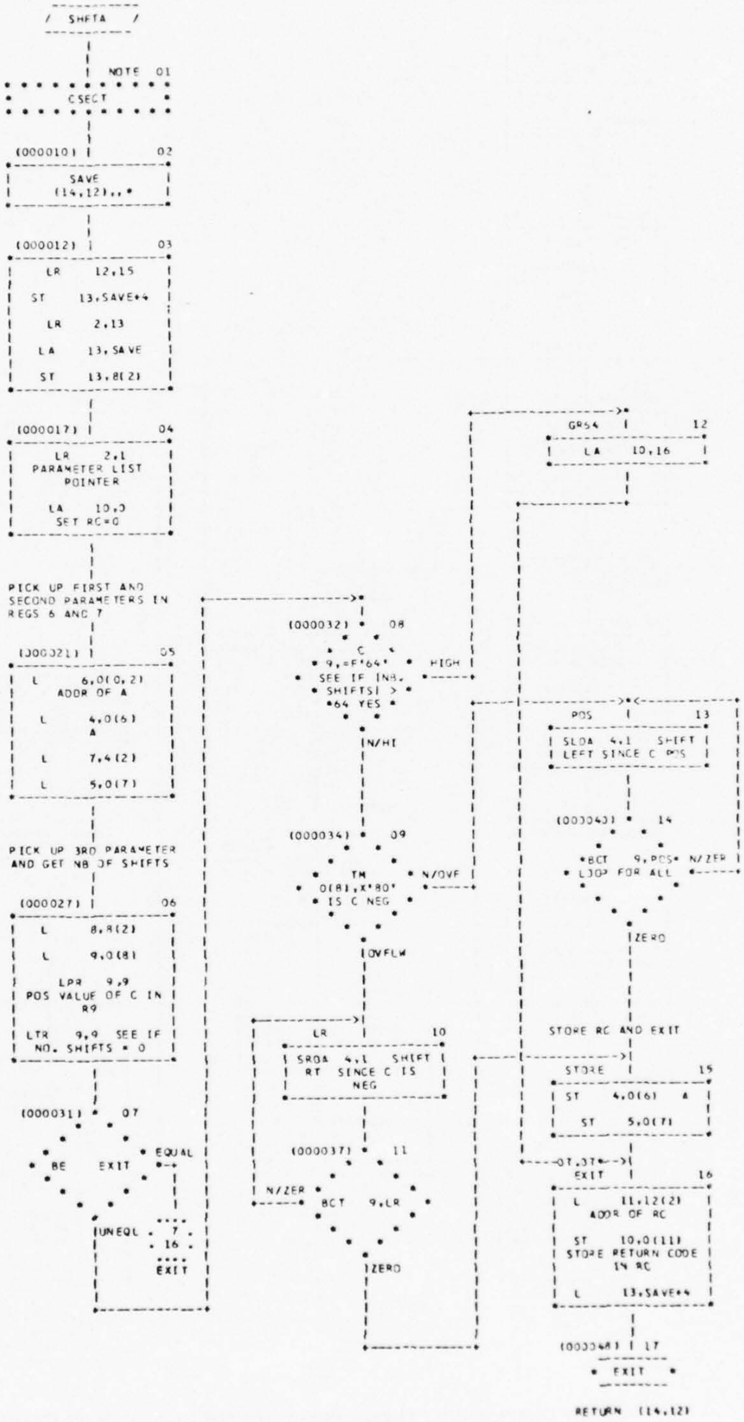
                                             *
                                    CFILE    I          01
                                  *---------------------*
                                  I SAVEM (14,12) ,*    I
                                  *---------------------*
                                             I
                                             I
                                  (GET 0328)I           02
                                  *---------------------*
                                  I          L          I
                                  I   10,=A(GETREC)     I
                                  *---------------------*
                                             I
                                             I
                                  (GET 1330)I           03
                                  *---------------------*
                                  I          L          I
                                  I   11,=V(GETDAT)     I
                                  *---------------------*
                                             I
                                             I
                                  (GET 1332)I           04
                                  *---------------------*
                                  I  LA    12,DCB       I
                                  *---------------------*
                                             I
                                             I
                                             I
                                            ...
                                          .     .
                                          . 2.17.
                                          .     .
                                            ... EOF
```

Flow Chart A-59   Group Phase Library Raw Data Tape Reader (concluded)

CHART TITLE -

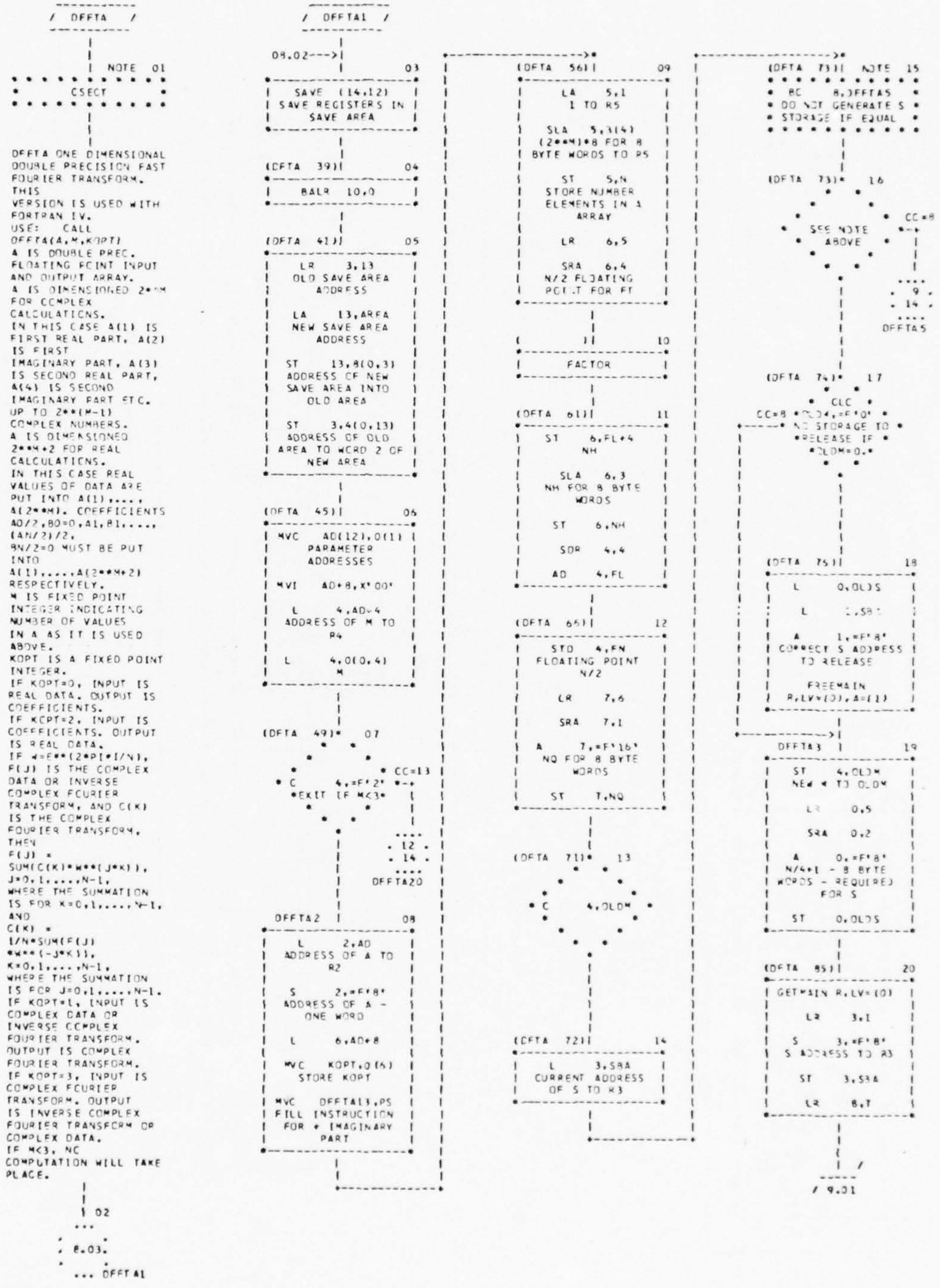


Flow Chart A-60 Group Phase Library Logical Shift Routine

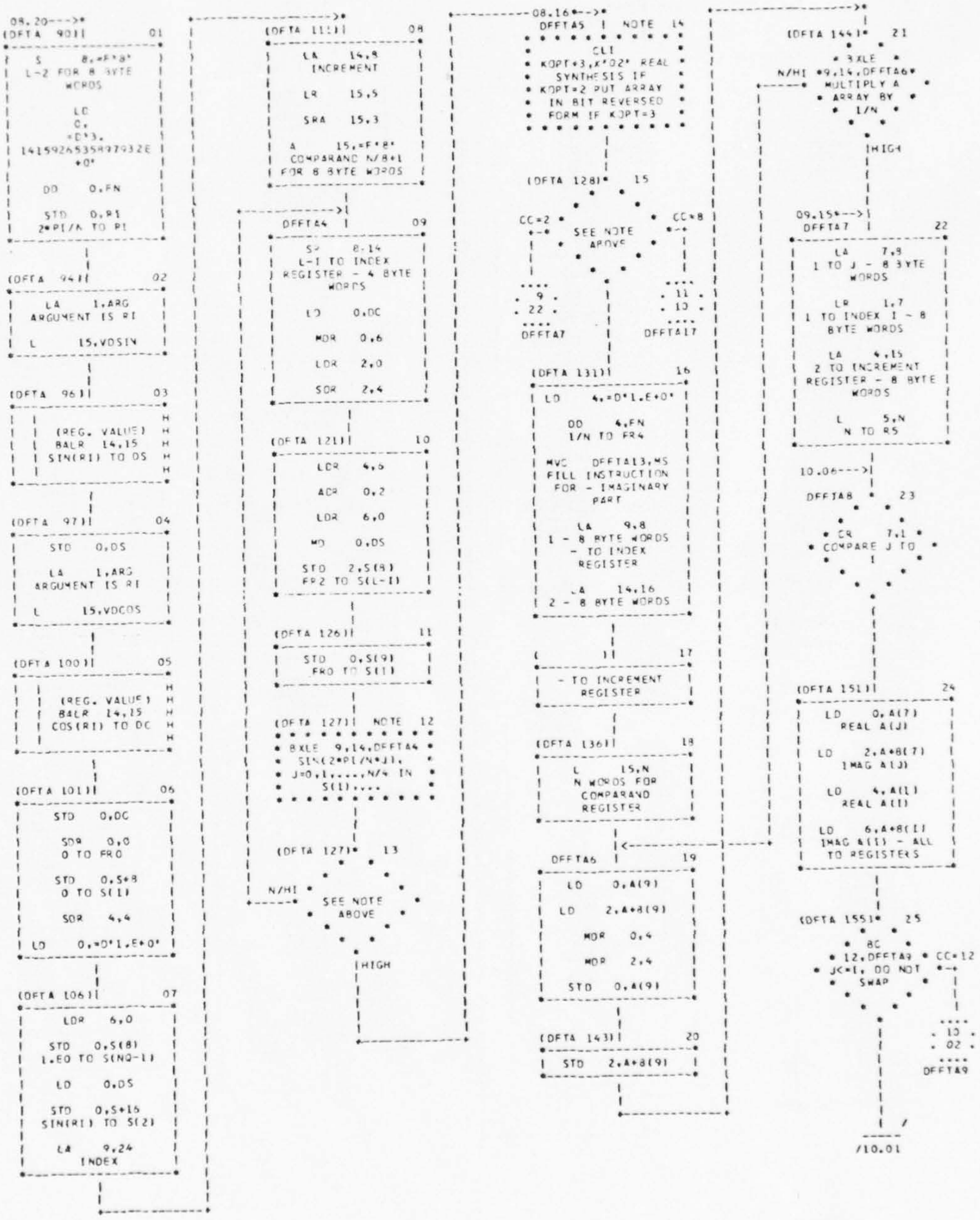


Flow Chart A-61 Group Phase Library Arithmetic Shift Routine

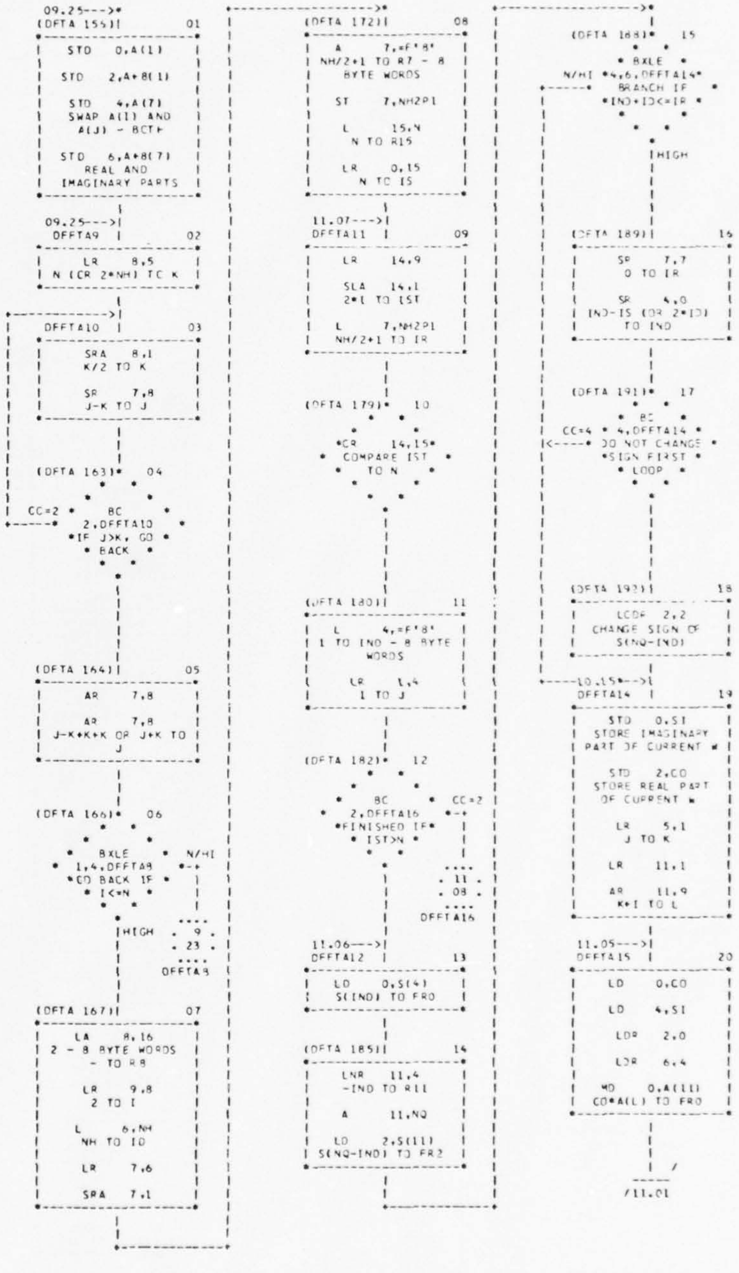
CHART TITLE -



Flow Chart A-62 Group Phase Library Fast Fourier Transform

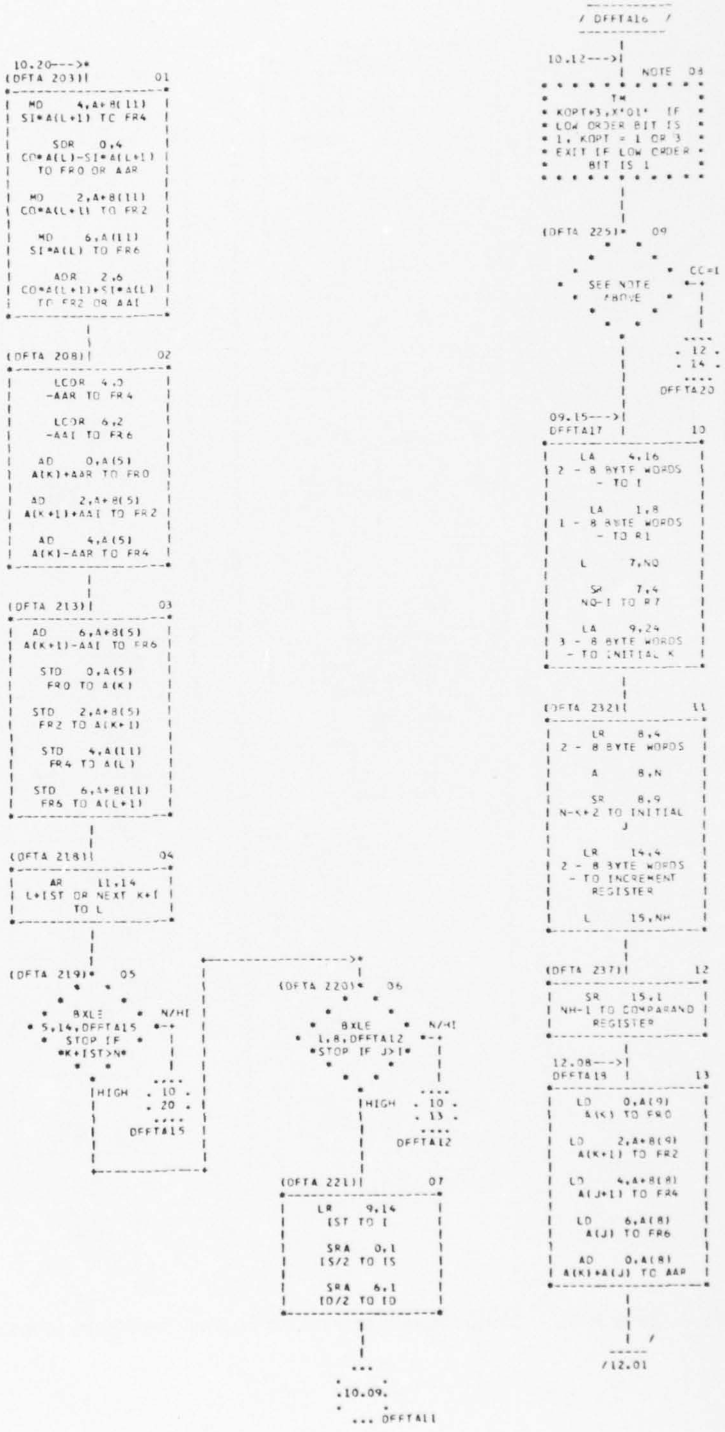


Flow Chart A-62 Group Phase Library Fast Fourier Transform (continued)



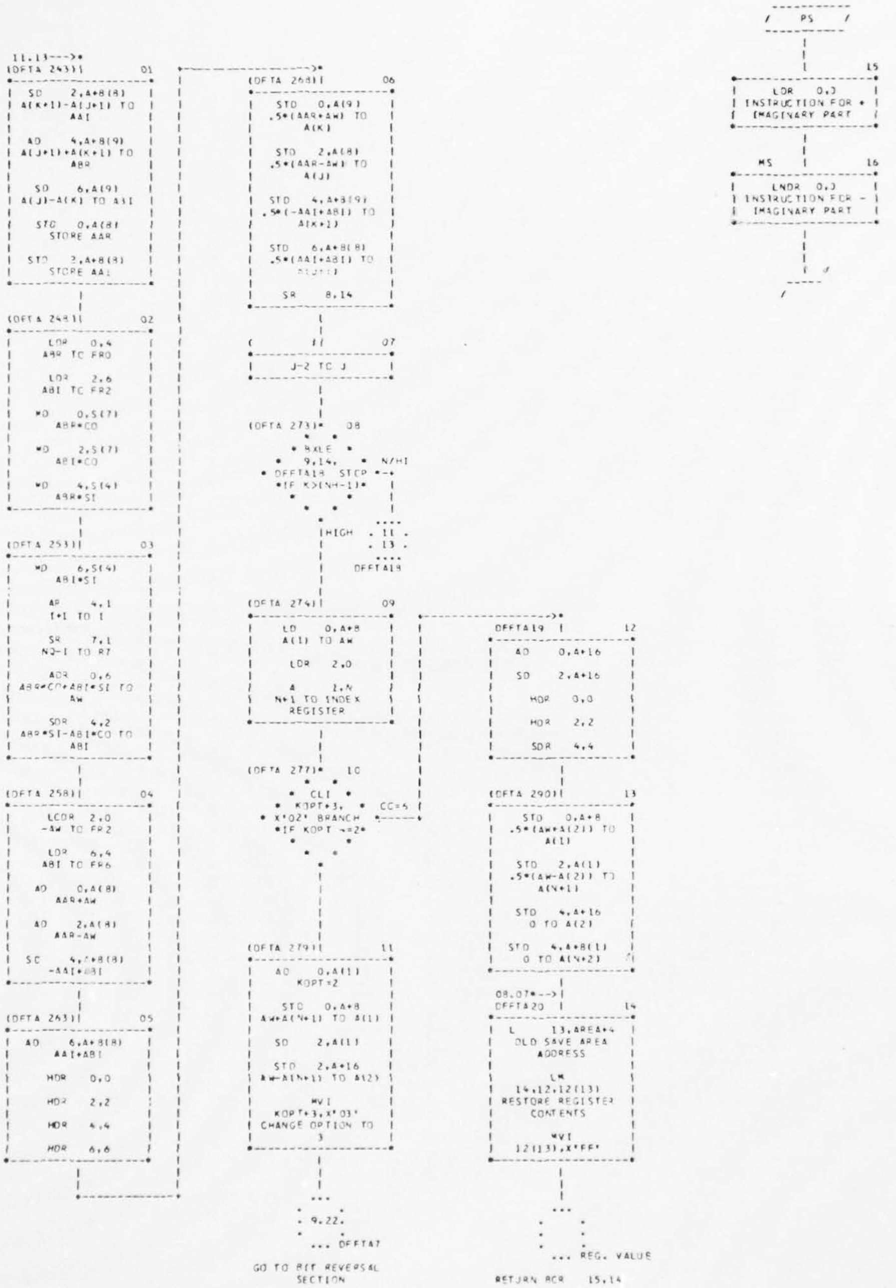
Flow Chart A-62 Group Phase Library Fast Fourier Transform (continued)

CHART TITLE -



Flow Chart A-62 Group Phase Library Fast Fourier Transform (continued)

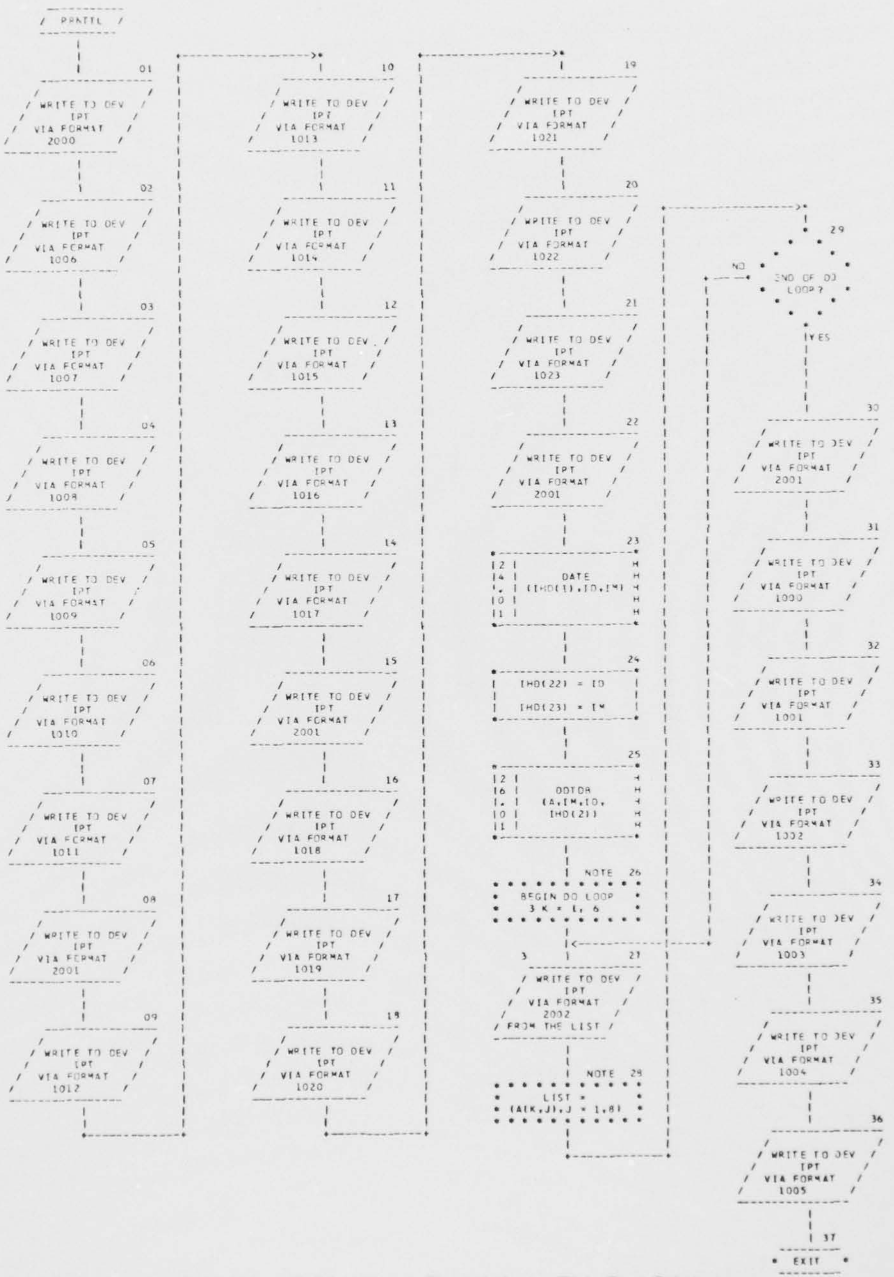
CHART TITLE -



Flow Chart A-62 Group Phase Library Fast Fourier Transform (concluded)

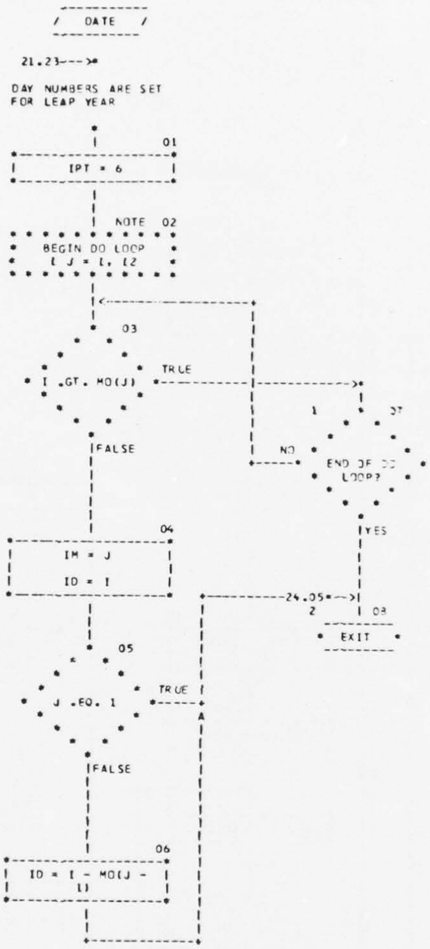
)

CHART TITLE - SUBROUTINE PRNTTL(IHD,IPT)


PRNTTL
01 WRITE TO DEV IPT VIA FORMAT 2000
02 WRITE TO DEV IPT VIA FORMAT 1006
03 WRITE TO DEV IPT VIA FORMAT 1007
04 WRITE TO DEV IPT VIA FORMAT 1008
05 WRITE TO DEV IPT VIA FORMAT 1009
06 WRITE TO DEV IPT VIA FORMAT 1010
07 WRITE TO DEV IPT VIA FORMAT 1011
08 WRITE TO DEV IPT VIA FORMAT 2001
09 WRITE TO DEV IPT VIA FORMAT 1012
10 WRITE TO DEV IPT VIA FORMAT 1013
11 WRITE TO DEV IPT VIA FORMAT 1014
12 WRITE TO DEV IPT VIA FORMAT 1015
13 WRITE TO DEV IPT VIA FORMAT 1016
14 WRITE TO DEV IPT VIA FORMAT 1017
15 WRITE TO DEV IPT VIA FORMAT 2001
16 WRITE TO DEV IPT VIA FORMAT 1018
17 WRITE TO DEV IPT VIA FORMAT 1019
18 WRITE TO DEV IPT VIA FORMAT 1020
19 WRITE TO DEV IPT VIA FORMAT 1021
20 WRITE TO DEV IPT VIA FORMAT 1022
21 WRITE TO DEV IPT VIA FORMAT 1023
22 WRITE TO DEV IPT VIA FORMAT 2001
23 DATE (IHD(1),ID,IM)
24 IHD(22) = ID IHD(23) = IM
25 DDTOR (A,IM,ID, IHD(2))
NOTE 26 BEGIN DO LOOP 3 K = 1, 6
3 27 WRITE TO DEV IPT VIA FORMAT 2002 FROM THE LIST
NOTE 28 LIST = (A(K,J),J = 1,8)
29 END OF DO LOOP ?
NO
YES
30 WRITE TO DEV IPT VIA FORMAT 2001
31 WRITE TO DEV IPT VIA FORMAT 1000
32 WRITE TO DEV IPT VIA FORMAT 1001
33 WRITE TO DEV IPT VIA FORMAT 1002
34 WRITE TO DEV IPT VIA FORMAT 1003
35 WRITE TO DEV IPT VIA FORMAT 1004
36 WRITE TO DEV IPT VIA FORMAT 1005
37 EXIT

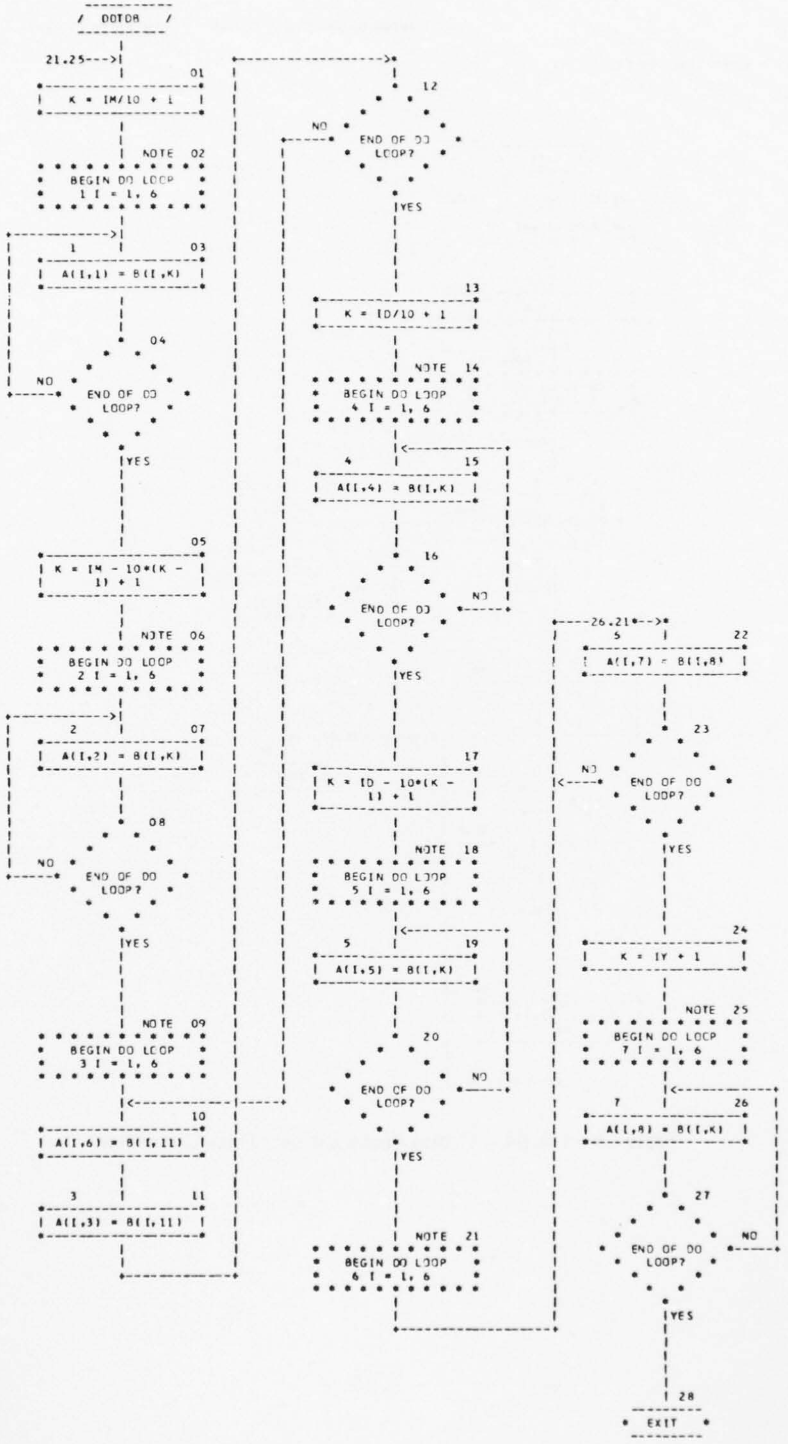
Flow Chart A-63 Group Phase Library Title Page Printer

CHART TITLE - SUBROUTINE DATE(I,ID,IM)



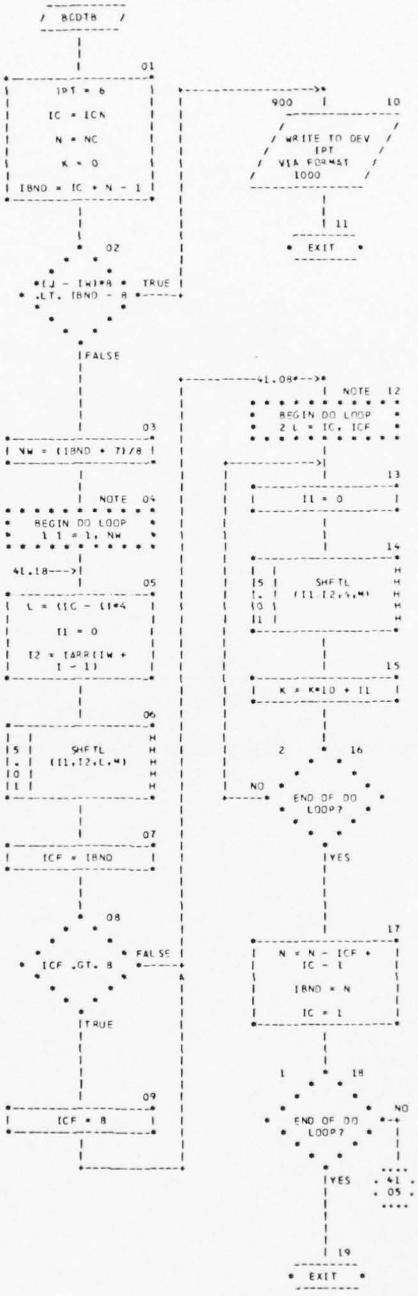
Flow Chart A-64 Group Phase Library Date Converter

CHART TITLE - SUBROUTINE DDTDB(A,IM,ID,IY)



Flow Chart A-65 Group Phase Library Date Formatter

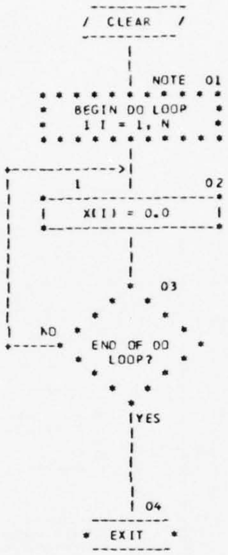
CHART TITLE - SUBROUTINE BCDTB(IW,ICN,NC,IARR,J,K)



Flow Chart A-66 Group Phase Library BCD to Binary Converter

09/28/76 AUTOFLOW CHART SET - LORAN GROUP PHASE LIBRARY PAGE 43

CHART TITLE - SUBROUTINE CLEAR(X,N)



Flow Chart A-67 Group Phase Library Array Reset

Appendix B

VOLTAGE MEASUREMENTS AND OTHER DATA

This appendix contains a tabulation of the means of each of 32 voltage measurements made at each field site and simultaneously at NAVOBSY. These means are the averages of second-stage edited data taken over 20-min periods. At each field site and at NAVOBSY data were taken for 1 h. Therefore, the data are conveniently broken into three segments, i.e., the first, second, and third 20-min periods.

The mean voltage measurements in volts are presented in Table B-1. This table also contains "other" data. These data are the year and day number, hour of the day, minute, second, block time, time difference, distance, and attenuation (see the key tabulated on the first page of Table B-1). Time is UTC. The "block time" is the time of the first mean voltage measurement in the data segment in milliseconds modulo 1 s. The "time difference" is the difference in time at the field site relative to NAVOBSY. The "distance" is the distance from the measurement antenna to the transmitting station in kilometers. The "attenuation" is the attenuation in decibels that was introduced into the measurement system to achieve the desired voltage at the A to D converter (see Volume C).

The nominal times of the voltage measurements in microseconds relative to the start of the pulse are given in Table B-2. There are two exceptions. All the measurements made at the field site at Marietta, OH, were made 5 μs later than the nominal values, and the measurements of segment 2 made with the field site equipment at NAVOBSY on 1975 day number 188 were made 5 μs earlier.

All the voltage data of Table B-1 are plotted in Figs. B-1 through B-12. The sample points where the measurements were made were located on the pulse such that the odd-numbered samples were near zero crossings and the even near peaks. Thus, the odd-numbered samples were very nearly in quadrature with the carrier and the even in phase (see Fig. 2 in the main body of the text).

The quality of the data is indicated in Table B-3 by the signal-to-noise ratios of the edited data. These signal-to-noise ratios were computed on a "per pulse" basis. The signal-to-noise ratios shown for stage 2 edited data in Table B-3 apply to the data tabulated in Table B-1 and plotted in Figs. B-1 through B-12.

Table B-1

Voltage Measurements and Other Data

(Key)

NAVOBSY	Segment 1	Voltage 1	Voltage 2	Voltage 3	Voltage 4	Voltage 5	Voltage 6	Voltage 7	Voltage 8
		Voltage 9	Voltage 10	Voltage 11	Voltage 12	Voltage 13	Voltage 14	Voltage 15	Voltage 16
		Voltage 17	Voltage 18	Voltage 19	Voltage 20	Voltage 21	Voltage 22	Voltage 23	Voltage 24
		Voltage 25	Voltage 26	Voltage 27	Voltage 28	Voltage 29	Voltage 30	Voltage 31	Voltage 32
		Year.Day	Hour	Minute	Second	Block Time	Time Diff.	Distance	Attenuation
	Segment 2	Voltage 1	Voltage 2	Voltage 3	Voltage 4	Voltage 5	Voltage 6	Voltage 7	Voltage 8
		Voltage 9	Voltage 10	Voltage 11	Voltage 12	Voltage 13	Voltage 14	Voltage 15	Voltage 16
		Voltage 17	Voltage 18	Voltage 19	Voltage 20	Voltage 21	Voltage 22	Voltage 23	Voltage 24
		Voltage 25	Voltage 26	Voltage 27	Voltage 28	Voltage 29	Voltage 30	Voltage 31	Voltage 32
		Year.Day	Hour	Minute	Second	Block Time	Time Diff.	Distance	Attenuation
	Segment 3	Voltage 1	Voltage 2	Voltage 3	Voltage 4	Voltage 5	Voltage 6	Voltage 7	Voltage 8
		Voltage 9	Voltage 10	Voltage 11	Voltage 12	Voltage 13	Voltage 14	Voltage 15	Voltage 16
		Voltage 17	Voltage 18	Voltage 19	Voltage 20	Voltage 21	Voltage 22	Voltage 23	Voltage 24
		Voltage 25	Voltage 26	Voltage 27	Voltage 28	Voltage 29	Voltage 30	Voltage 31	Voltage 32
		Year.Day	Hour	Minute	Second	Block Time	Time Diff.	Distance	Attenuation
Field site	Segment 1	Voltage 1	Voltage 2	Voltage 3	Voltage 4	Voltage 5	Voltage 6	Voltage 7	Voltage 8
		Voltage 9	Voltage 10	Voltage 11	Voltage 12	Voltage 13	Voltage 14	Voltage 15	Voltage 16
		Voltage 17	Voltage 18	Voltage 19	Voltage 20	Voltage 21	Voltage 22	Voltage 23	Voltage 24
		Voltage 25	Voltage 26	Voltage 27	Voltage 28	Voltage 29	Voltage 30	Voltage 31	Voltage 32
		Year.Day	Hour	Minute	Second	Block Time	Time Diff.	Distance	Attenuation
	Segment 2	Voltage 1	Voltage 2	Voltage 3	Voltage 4	Voltage 5	Voltage 6	Voltage 7	Voltage 8
		Voltage 9	Voltage 10	Voltage 11	Voltage 12	Voltage 13	Voltage 14	Voltage 15	Voltage 16
		Voltage 17	Voltage 18	Voltage 19	Voltage 20	Voltage 21	Voltage 22	Voltage 23	Voltage 24
		Voltage 25	Voltage 26	Voltage 27	Voltage 28	Voltage 29	Voltage 30	Voltage 31	Voltage 32
		Year.Day	Hour	Minute	Second	Block Time	Time Diff.	Distance	Attenuation
	Segment 3	Voltage 1	Voltage 2	Voltage 3	Voltage 4	Voltage 5	Voltage 6	Voltage 7	Voltage 8
		Voltage 9	Voltage 10	Voltage 11	Voltage 12	Voltage 13	Voltage 14	Voltage 15	Voltage 16
		Voltage 17	Voltage 18	Voltage 19	Voltage 20	Voltage 21	Voltage 22	Voltage 23	Voltage 24
		Voltage 25	Voltage 26	Voltage 27	Voltage 28	Voltage 29	Voltage 30	Voltage 31	Voltage 32
		Year.Day	Hour	Minute	Second	Block Time	Time Diff.	Distance	Attenuation

Table B-1 (continued)

```
FIELD SITE: WILMINGTON,NC          STATION: CAROLINA BEACH     XMTR: 19

   .00774   -.02584    -.01532     .05631      .02256   -.10326   -.02975     .16843
   .03307   -.24823    -.03254     .33842      .02515   -.43280   -.01207     .52222
   .03263   -.71975    -.10282     .76834      .12343   -.67351   -.05860     .42083
  -.03864   -.09162     .12139    -.12748     -.13826    .16473    .06997    -.09604
1975.177   19.00000   30.00000     .00000   713.93690    .00000 544.24396   17.

   .00764   -.02595    -.01510     .05611      .02241   -.10274   -.03018     .16836
   .03338   -.24843    -.03255     .33869      .02476   -.43267   -.01173     .52186
   .03247   -.72027    -.10310     .76743      .12519   -.66693   -.06207     .40740
  -.03429   -.07135     .11835    -.14904     -.13573    .18307    .06688    -.10684
1975.177   19.00000   51.00000     .00000   235.13690    .00000 544.24396   17.

   .00757   -.02558    -.01503     .05599      .02183   -.10196   -.02920     .16663
   .03256   -.24566    -.03224     .33529      .02497   -.42902   -.01174     .51746
   .03244   -.71389    -.10213     .76065      .12346   -.66279   -.06125     .40724
  -.03442   -.07582     .11707    -.14205     -.13390    .17650    .06676    -.10272
1975.177   20.00000   12.00000     .00000   451.43690    .00000 544.24396   17.

   .00918   -.02496    -.01671     .05501      .02286   -.10179   -.02766     .16346
   .02920   -.23799    -.02518     .31941      .01788   -.40350    .00024     .48046
   .04009   -.64459    -.10048     .67389      .11372   -.57378   -.05688     .33714
  -.03235   -.04814     .10064    -.13044     -.10818    .14214    .04421    -.07130
1975.177   19.00000   30.00000     .00000   712.20320   6.64600  23.57207   46.

   .00917   -.02503    -.01670     .05515      .02277   -.10189   -.02769     .16354
   .02927   -.23800    -.02525     .31927      .01796   -.40337    .00015     .48020
   .04015   -.64402    -.10100     .67343      .11410   -.57355   -.05713     .33708
  -.03212   -.04844     .10038    -.13000     -.10804    .14173    .04402    -.07112
1975.177   19.00000   51.00000     .00000   233.40320   6.64600  23.57207   46.

   .00904   -.02491    -.01648     .05473      .02248   -.10110   -.02728     .16219
   .02890   -.23598    -.02508     .31658      .01774   -.40004    .00037     .47600
   .03950   -.63918    -.09980     .66804      .11272   -.56883   -.05639     .33467
  -.03229   -.04862     .09989    -.12821     -.10742    .13986    .04389    -.07013
1975.177   20.00000   12.00000     .00000   449.70320   6.64600  23.57207   46.
```

Table B-1 (continued)

```
FIELD SITE: EMPORIA,VA          STATION: CAROLINA BEACH    XMTR: 19

     .01082     -.02956     -.01958      .06305      .02777     -.11347     -.03573      .18180
     .03934     -.26432     -.03864      .35702      .03010     -.45541     -.01588      .55060
     .03878     -.77805     -.13440      .85982      .18091     -.77559     -.13628      .48607
     .02083     -.09786      .10270     -.15556     -.14886      .19493      .08304     -.11553
 1975.175     19.00000    30.00000      .00000   343.43710      .00000   544.24396     16.

     .01049     -.02861     -.01823      .06086      .02502     -.10864     -.03199      .17371
     .03496     -.25301     -.03337      .34216      .02428     -.43654     -.00830      .52700
     .04685     -.74498     -.14087      .82120      .18388     -.73934     -.13994      .46157
     .02338     -.09314      .09817     -.14674     -.14212      .18492      .07841     -.11003
 1975.175     19.00000    51.00000      .00000   559.73710      .00000   544.24396     16.

     .01060     -.02895     -.01865      .06157      .02584     -.11019     -.03323      .17633
     .03655     -.25685     -.03526      .34735      .02621     -.44307     -.01069      .53519
     .04468     -.75605     -.13832      .83503      .18169     -.75149     -.13389      .46869
     .01367     -.09309      .11134     -.15203     -.15693      .19253      .09031     -.11717
 1975.175     20.00000    12.00000      .00000   776.03710      .00000   544.24396     16.


     .01142     -.02879     -.01936      .06177      .02514     -.11240     -.02992      .17710
     .03037     -.25672     -.02547      .34227      .01588     -.43413      .00252      .52001
     .05972     -.72233     -.15041      .78836      .18637     -.70123     -.13412      .42662
     .01280     -.07695      .10529     -.14235     -.14562      .16522      .08050     -.09339
 1975.175     19.00000    30.00000      .00000   342.60520     6.44600   293.34381     23.

     .01068     -.02770     -.01795      .05919      .02279     -.10770     -.02674      .16968
     .02670     -.24581     -.02142      .32797      .01104     -.41517      .01089      .49803
     .06544     -.69066     -.15782      .75110      .19213     -.66575     -.13771      .40334
     .01544     -.07293      .10171     -.13211     -.13981      .15240      .07518     -.08562
 1975.175     19.00000    51.00000      .00000   558.90520     6.44600   293.34381     23.

     .01097     -.02824     -.01851      .06022      .02369     -.10937     -.02796      .17221
     .02813     -.24951     -.02293      .33276      .01306     -.42153      .00803      .50555
     .06356     -.70095     -.15510      .76317      .19016     -.67667     -.13640      .41037
     .01445     -.07471      .10317     -.13331     -.14255      .15249      .07822     -.08287
 1975.175     20.00000    12.00000      .00000   775.20520     6.44600   293.34381     23.
```

Table B-1 (continued)

```
FIELD SITE: TOWANDA,PA          STATION: CAROLINA BEACH    XMTR: 20

    .01175    -.02400    -.02036     .05285      .02994   -.09998    -.03685     .16329
    .03970    -.24184    -.03652     .32843      .02781   -.42025    -.01308     .50681
    .02934    -.71883    -.09869     .80186      .13021   -.74844    -.08986     .51468
    .02418    -.16145     .04665    -.12157     -.08840    .21171     .07277    -.14923
1975.183    19.00000   30.00000    1.00000   924.73660    .00000  544.24396   16.

    .01208    -.02385    -.02122     .05318      .03095   -.10069    -.03821     .16457
    .04113    -.24373    -.03774     .33016      .02948   -.42247    -.01508     .50892
    .02557    -.72327    -.09487     .80884      .12516   -.75813    -.08246     .52718
    .01588    -.17554     .05451    -.10727     -.09459    .19819     .07685    -.13963
1975.183    19.00000   51.00000     .00000   750.83660    .00000  544.24396   16.

    .01184    -.02439    -.02048     .05348      .03012   -.10091    -.03731     .16495
    .03996    -.24418    -.03625     .33087      .02749   -.42327    -.01265     .50990
    .02947    -.72469    -.09987     .81081      .13294   -.76340    -.09294     .53654
    .02711    -.18781     .04406    -.09430     -.08637    .18689     .07176    -.13385
1975.183    20.00000   12.00000     .00000   272.03660    .00000  544.24396   16.


    .00454    -.02276    -.00866     .04751      .00892   -.08697    -.01201     .13645
    .00854    -.19917    -.00630     .26606     -.00266   -.33863     .01109     .40677
    .04212    -.57326    -.10237     .63355      .13586   -.57180    -.11305     .36517
    .06362    -.07799    -.01586    -.13237     -.01788    .17867     .02570    -.10495
1975.183    19.00000   30.00000    1.00000   925.82550   6.98700  867.73125    6.

    .00475    -.02021    -.00968     .04507      .01093   -.08531    -.01493     .13565
    .01231    -.19960    -.01090     .26822      .00179   -.34223     .00704     .41160
    .04057    -.57993    -.10532     .64353      .14329   -.58782    -.12574     .38633
    .08368    -.09849    -.04040    -.11751      .00303    .17218     .01546    -.10647
1975.183    19.00000   51.00000     .00000   751.92550   6.98700  867.73125    6.

    .00616    -.02340    -.00996     .04858      .00997   -.08822    -.01285     .13788
    .00939    -.20089    -.00713     .26857     -.00223   -.34159     .01116     .41033
    .04368    -.57890    -.10782     .64584      .14784   -.59402    -.13435     .39090
    .09089    -.09968    -.04148    -.11605     -.00041    .16897     .01930    -.10269
1975.183    20.00000   12.00000     .00000   273.12550   6.98700  867.73125    6.
```

Table B-1 (continued)

```
FIELD SITE: DEXTER,NY             STATION: CAROLINA BEACH    XMTR: 19

     .00779    -.02653    -.01420     .05623     .02139    -.10372    -.02905      .16928
     .03362    -.25181    -.03412     .34397     .02821    -.44152    -.01627      .53300
     .02372    -.73786    -.08731     .78576     .10026    -.68710    -.03583      .42748
    -.05594    -.08961     .12665    -.13618    -.13035     .17411     .05762     -.10029
 1975.181    19.00000   30.00000     .00000  561.23680     .00000  544.24396   17.

     .00714    -.02579    -.01430     .05559     .02201    -.10315    -.02947      .16885
     .03350    -.24998    -.03362     .34085     .02839    -.43694    -.01846      .52739
     .01765    -.73201    -.08027     .78294     .09944    -.67904    -.03465      .41223
    -.05608    -.07457     .12120    -.15359    -.12303     .19395     .05545     -.11014
 1975.181    19.00000   51.00000    2.00000  167.73680     .00000  544.24396   17.

     .00727    -.02636    -.01380     .05595     .02139    -.10340    -.02860      .16903
     .03250    -.25053    -.03210     .34149     .02615    -.43757    -.01578      .52810
     .02061    -.73307    -.08361     .78347     .10228    -.67980    -.03364      .41464
    -.06112    -.07734     .12921    -.15110    -.13223     .19177     .06297     -.10988
 1975.181    20.00000   12.00000     .00000  298.73680     .00000  544.24396   17.


     .00033    -.01146    -.00024     .02414    -.00089    -.04284     .00104      .06757
    -.00285    -.09680     .00412     .12909    -.00693    -.16096     .01042      .19280
     .02112    -.26384    -.03908     .29161     .04481    -.26391    -.02071      .17264
    -.00795    -.05464     .02537    -.02527    -.02773     .04721     .01370     -.03294
 1975.181    19.00000   30.00000     .00000  563.14810    6.84200 1113.94586    6.

     .00016    -.01136    -.00019     .02381    -.00093    -.04256     .00087      .06721
    -.00269    -.09644     .00390     .12839    -.00675    -.15998     .00996      .19137
     .02113    -.26191    -.03759     .28898     .03949    -.26194    -.01313      .17193
    -.01714    -.05511     .03406    -.02433    -.03402     .04705     .01545     -.03389
 1975.181    19.00000   51.00000    2.00000  169.64810    6.84200 1113.94586    6.

     .00006    -.01153    -.00003     .02393    -.00128    -.04266     .00125      .06715
    -.00309    -.09642     .00422     .12847    -.00720    -.16033     .01063      .19183
     .02135    -.26205    -.03776     .28938     .03947    -.26292    -.01322      .17308
    -.01710    -.05636     .03412    -.02317    -.03403     .04648     .01550     -.03392
 1975.181    20.00000   12.00000     .00000  300.64810    6.84200 1113.94586    6.
```

Table B-1 (continued)

```
FIELD SITE: DANVILLE,IN            STATION: DANA              XMTR: 19

     .00105     -.00208     -.00192      .01414      .00299     -.03274     -.00314      .05709
     .00361     -.08792     -.00298      .12197      .00327     -.16090     -.00316      .19923
    -.00392     -.31012      .00092      .37752      .00854     -.37440     -.02621      .27512
     .04822     -.11474     -.05946     -.02712      .04955      .08490     -.01945     -.06526
 1975.163     19.00000    30.00000      .00000   970.59740      .00000   903.08343     6.

     .00132     -.00134     -.00217      .01288      .00334     -.03209     -.00351      .05664
     .00374     -.08827     -.00257      .12239      .00300     -.16150     -.00307      .20071
    -.00432     -.31120      .00137      .37974      .00557     -.37650     -.01991      .27544
     .04004     -.11316     -.05133     -.02996      .04287      .08699     -.01520     -.06527
 1975.163     19.00000    51.00000     3.00000   967.29740      .00000   903.08343     6.

     .00064     -.00143     -.00186      .01329      .00333     -.03304     -.00339      .05775
     .00394     -.08953     -.00298      .12360      .00358     -.16237     -.00398      .20125
    -.00542     -.31315      .00138      .38202      .00739     -.38118     -.02525      .28157
     .04625     -.11999     -.05840     -.02497      .04923      .08444     -.01946     -.06528
 1975.163     20.00000    12.00000      .00000   708.09740      .00000   903.08343     6.

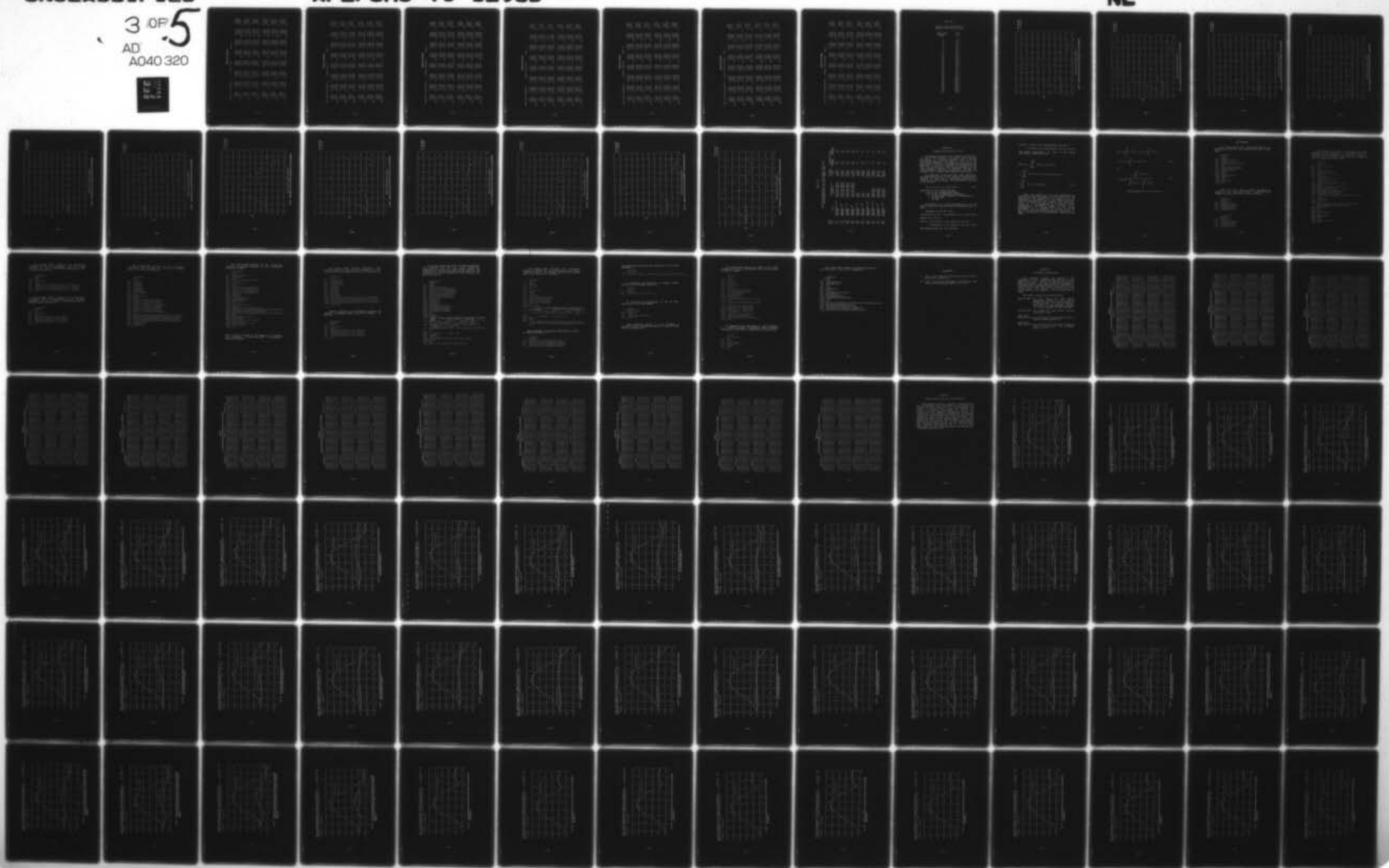

     .01171     -.02355     -.01648      .05275      .01519     -.09491     -.01245      .15009
     .00589     -.21614     -.00020      .29057     -.01010     -.36950      .01746      .44692
     .03718     -.65275     -.07248      .75402      .10290     -.70906     -.12200      .46226
     .12284     -.10429     -.09046     -.16814      .02970      .23243      .02393     -.12013
 1975.163     19.00000    30.00000      .00000   967.87130     5.08500    85.94620    30.

     .01194     -.02351     -.01678      .05294      .01559     -.09535     -.01286      .15081
     .00641     -.21704     -.00071      .29165     -.00934     -.37065      .01684      .44810
     .03628     -.65416     -.07201      .75580      .10242     -.71154     -.12221      .46462
     .12358     -.10592     -.09143     -.16740      .03018      .23264      .02408     -.12094
 1975.163     19.00000    51.00000     3.00000   964.57130     5.08500    85.94620    30.

     .01195     -.02364     -.01677      .05323      .01572     -.09573     -.01305      .15132
     .00679     -.21761     -.00106      .29233     -.00880     -.37147      .01658      .44899
     .03574     -.65539     -.07194      .75726      .10270     -.71254     -.12313      .46484
     .12498     -.10474     -.09282     -.16942      .03091      .23465      .02461     -.12191
 1975.163     20.00000    12.00000      .00000   705.37130     5.08500    85.94620    30.
```

AD-A040 320 JOHNS HOPKINS UNIV LAUREL MD APPLIED PHYSICS LAB F/G 17/7
EXPERIMENTAL RESEARCH ON THE PROPAGATION OF LORAN-C SIGNALS. VO--ETC(U)
JAN 77 L F FEHLNER, T W JERARDI, T A MCCARTY N00017-72-C-4401
UNCLASSIFIED APL/JHU-TG-1298D NL

3 OF 5
AD
A040 320



OF 5

0320

Table B-1 (continued)

```
FIELD SITE: MARIETTA,OH          STATION: DANA            XMTR: 19

     .00427    -.00274    -.00420     .01391     .00446    -.03363    -.00442     .05850
     .00320    -.08947    -.00253     .12288     .00150    -.16060    -.00078     .19680
     .00117    -.29843    -.00994     .35427     .02031    -.33728    -.03411     .22787
     .05111    -.06623    -.05329    -.06335     .03682     .10440    -.00481    -.06642
 1975.161    19.00000   30.00000     .00000  798.69740     .00000  903.08343    6.

     .00415    -.00276    -.00384     .01328     .00513    -.03450    -.00327     .05739
     .00359    -.08929    -.00261     .12266     .00160    -.16011    -.00186     .19773
     .00061    -.29783    -.00899     .35360     .02025    -.33583    -.03491     .22493
     .05296    -.06361    -.05622    -.06571     .03865     .10621    -.00628    -.06749
 1975.161    19.00000   51.00000     .00000  319.89740     .00000  903.08343    6.

     .00427    -.00281    -.00426     .01402     .00424    -.03374    -.00378     .05789
     .00292    -.08917    -.00215     .12255     .00126    -.16072    -.00020     .19693
     .00203    -.29874    -.00932     .35548     .01863    -.33902    -.03151     .23001
     .04765    -.06952    -.05011    -.05979     .03422     .10169    -.00450    -.06554
 1975.161    20.00000   12.00000    1.00000  231.29740     .00000  903.08343    6.


    -.01256     .04341     .01401    -.07881    -.01262     .12551     .00914    -.18077
    -.00458     .24520    -.00044    -.31187     .00550     .38132    -.01248    -.44542
    -.02856     .60636     .05847    -.66472    -.09050     .57653     .11578    -.32343
    -.11933     .02274     .08366     .16733    -.01602    -.17949    -.03987     .06732
 1975.161    19.00000   30.00000     .00000  797.44440    4.96600  526.90533   12.

    -.01259     .04291     .01431    -.07831    -.01321     .12504     .01009    -.18034
    -.00585     .24488     .00104    -.31176     .00371     .38134    -.01088    -.44570
    -.02602     .60720     .05648    -.66640    -.08904     .58012     .11473    -.32926
    -.11969     .03038     .08521     .15934    -.01820    -.17290    -.03807     .06365
 1975.161    19.00000   51.00000     .00000  318.64440    4.96600  526.90533   12.

    -.01255     .04305     .01401    -.07840    -.01267     .12510     .00930    -.18037
    -.00481     .24487    -.00030    -.31160     .00553     .38109    -.01256    -.44529
    -.02873     .60636     .05905    -.66564    -.09189     .58017     .11887    -.33151
    -.12365     .03467     .08915     .15359    -.02250    -.16710    -.03404     .06010
 1975.161    20.00000   12.00000    1.00000  230.04440    4.96600  526.90533   12.
```

Table B-1 (continued)

```
FIELD SITE: GEORGETOWN,DE        STATION: DANA              XMTR: 19

    .00088   -.00076   -.00143    .01327   -.00016   -.03206     .00044    .05726
   -.00267   -.08802    .00392    .12226   -.00576   -.16081     .00744    .19852
    .01163   -.30103   -.02404    .35610    .03650   -.33156    -.05048    .21562
    .06246   -.05159   -.05986   -.07662    .03798    .11468    -.00522   -.07028
1975.156   19.00000  30.00000    .00000 617.19730    .00000  903.08343   6.

    .00140   -.00070   -.00191    .01277    .00092   -.03243     .00031    .05653
   -.00146   -.08831    .00332    .12239   -.00539   -.16064     .00632    .19949
    .01011   -.30596   -.02250    .36910    .03672   -.35538    -.05356    .24794
    .06873   -.08663   -.06872   -.04600    .04857    .09671    -.01431   -.06731
1975.156   19.00000  51.00000    .00000 138.39730    .00000  903.08343   6.

    .00129   -.00068   -.00163    .01300    .00052   -.03283     .00077    .05733
   -.00221   -.08910    .00381    .12363   -.00577   -.16249     .00692    .20156
    .01148   -.30884   -.02535    .37289    .04114   -.35911    -.05905    .25018
    .07398   -.08633   -.07282   -.04992    .05040    .10242    -.01423   -.07163
1975.156   20.00000  12.00000    .00000 354.69730    .00000  903.08343   6.


    .00127   -.00777   -.00082    .01690   -.00216   -.03011     .00435    .04674
   -.00770   -.06797    .01033    .09127   -.01461   -.11667     .01851    .14178
    .02843   -.20812   -.04887    .24427    .06425   -.22754    -.07442    .14942
    .07373   -.04154   -.05770   -.04205    .02682    .06678     .00477   -.03926
1975.156   19.00000  30.00000    .00000 617.70450   4.58000 1053.51698   6.

    .00164   -.00794   -.00111    .01677   -.00155   -.03002     .00357    .04694
   -.00672   -.06844    .00971    .09198   -.01442   -.11711     .01835    .14262
    .02861   -.20948   -.05235    .24679    .07241   -.23123    -.08648    .15281
    .08843   -.04266   -.07184   -.04249    .03710    .06948     .00085   -.04285
1975.156   19.00000  51.00000    .00000 138.90450   4.58000 1053.51698   6.

    .00118   -.00790   -.00092    .01666   -.00187   -.03025     .00354    .04738
   -.00735   -.06935    .01024    .09267   -.01517   -.11817     .01895    .14330
    .03028   -.20790   -.05401    .24092    .07372   -.21936    -.08519    .13754
    .08387   -.02608   -.06335   -.05699    .02565    .07677     .01095   -.04288
1975.156   20.00000  12.00000    .00000 355.20450   4.58000 1053.51698   6.
```

Table B-1 (continued)

```
FIELD SITE: TOMS RIVER,NJ        STATION: NANTUCKET        XMTR: 23

    .01104     -.02482     -.01493      .04858      .01630     -.08269     -.02030      .13051
    .01914     -.18772     -.01943      .25484      .01562     -.32948     -.00956      .40363
    .00736     -.61003     -.03984      .73088      .06612     -.72093     -.06865      .56035
    .04692     -.30189     -.00739      .04455     -.02457      .13371      .03331     -.20305
1975.149     19.00000    30.00000      .00000   147.65630      .00000   657.57608     8.

    .01315     -.02474     -.01910      .05163      .02229     -.09097     -.02558      .14300
    .02379     -.20438     -.02298      .27452      .01873     -.35128     -.01481      .42939
   -.00412     -.65714     -.02936      .79209      .05844     -.78227     -.05054      .62641
    .03604     -.35585     -.00281      .07163     -.03780      .11885      .03900     -.20620
1975.149     19.00000    51.00000     1.00000   158.35630      .00000   657.57608     8.

    .01290     -.02895     -.01631      .05378      .01988     -.09286     -.02268      .14296
    .02316     -.20486     -.02442      .27731      .02035     -.35547     -.01717      .43739
   -.00244     -.66608     -.03462      .80107      .06133     -.79401     -.05057      .63959
    .03532     -.36367      .00238      .07660     -.04352      .11643      .04121     -.20931
1975.149     20.00000    12.00000      .00000   679.55630      .00000   657.57608     8.

    .01172     -.02659     -.01702      .05488      .01933     -.09634     -.02127      .15087
    .01993     -.21786     -.01676      .29404      .01063     -.37738     -.00062      .45998
    .02066     -.68445     -.06156      .80552      .08184     -.77918     -.07183      .58558
    .03433     -.28746      .02103     -.00035     -.05870      .18983      .05482     -.25685
1975.149     19.00000    30.00000      .00000   146.74690     4.05700   384.34588    13.

    .01318     -.02946     -.01932      .05980      .02224     -.10460     -.02512      .16263
    .02457     -.23419     -.02221      .31528      .01714     -.40419     -.00866      .49254
    .01341     -.73396     -.05625      .86799      .07413     -.84914     -.06778      .64576
    .02944     -.32561      .02652      .01121     -.06331      .20051      .05667     -.28104
1975.149     19.00000    51.00000     1.00000   157.44690     4.05700   384.34588    13.

    .01346     -.02989     -.01947      .06096      .02248     -.10621     -.02525      .16510
    .02467     -.23748     -.02191      .31953      .01663     -.40944     -.00804      .49884
    .01517     -.74253     -.05924      .87872      .07772     -.85969     -.07023      .65526
    .02958     -.33231      .02962      .01534     -.06882      .19963      .06374     -.28205
1975.149     20.00000    12.00000      .00000   678.64690     4.05700   384.34588    13.
```

Table B-1 (continued)

```
FIELD SITE: GROTTOES,VA        STATION: NANTUCKET          XMTR: 23

     .01011     -.02735     -.01213       .05162      .01432     -.08888     -.01382      .13740
     .01244     -.19902     -.00763       .26809      .00204     -.34619      .00687      .42540
     .02650     -.65280     -.06061       .79603      .08153     -.80063     -.07510      .63493
     .04683     -.35304      .00359       .06444     -.03906      .14019      .04596     -.22860
  1975.170     19.00000    30.00000       .00000   512.75600      .00000   657.57608     8.

     .01077     -.02771     -.01315       .05280      .01531     -.09086     -.01512      .14071
     .01348     -.20348     -.00889       .27446      .00276     -.35412      .00664      .43483
     .02720     -.66655     -.06251       .81203      .08341     -.81722     -.07709      .64890
     .04735     -.36270      .00473       .06896     -.04161      .14020      .04915     -.23125
  1975.170     19.00000    51.00000       .00000   729.05600      .00000   657.57608     8.

     .01215     -.02754     -.01367       .05233      .01638     -.09199     -.01406      .14031
     .01212     -.20136     -.00804       .27107      .00204     -.34816      .00470      .42913
     .02561     -.65917     -.06053       .80501      .08074     -.81532     -.07214      .65634
     .04229     -.37932      .00961       .09095     -.04750      .11764      .05358     -.21414
  1975.170     20.00000    12.00000       .00000   250.25600      .00000   657.57608     8.


     .00136     -.01582     -.00147       .02944     -.00098     -.04979      .00289      .07625
    -.00669     -.10951      .00969       .14732     -.01405     -.18804      .01792      .22957
     .02755     -.34912     -.04222       .42386      .04784     -.42270     -.04223      .32859
     .02618     -.17691     -.00563       .02578     -.01190      .08169      .01708     -.12570
  1975.170     19.00000    30.00000       .00000   513.33110     5.92900   827.58950     3.

     .00187     -.01656     -.00215       .03042     -.00010     -.05154      .00196      .07895
    -.00608     -.11287      .00922       .15116     -.01332     -.19251      .01686      .23502
     .02753     -.35639     -.04390       .43055      .05255     -.42487     -.04800      .32595
     .03299     -.16866     -.01182       .01502     -.00843      .09003      .01606     -.13139
  1975.170     19.00000    51.00000       .00000   729.63110     5.92900   827.58950     3.

     .00180     -.01620     -.00237       .03031      .00025     -.05127      .00149      .07819
    -.00533     -.11165      .00803       .14966     -.01202     -.19076      .01565      .23279
     .02591     -.35241     -.03938       .42626      .04323     -.42122     -.03499      .32322
     .01683     -.16802      .00411       .01451     -.02105      .09069      .02281     -.13162
  1975.170     20.00000    12.00000       .00000   250.83110     5.92900   827.58950     3.
```

Table B-1 (continued)

```
FIELD SITE: BLUEFIELD,WV         STATION: NANTUCKET          XMTR: 23

     .00931    -.02835    -.01485     .05312      .01917    -.08897    -.02263     .13654
     .02318    -.19605    -.02079     .26404      .01633    -.34082    -.00964     .41951
     .00443    -.64473     .02615     .77767      .04143    -.77595    -.03929     .61410
     .01442    -.33858     .02534     .05454     -.04608     .13993     .04285    -.21987
1975.168     19.00000   30.00000      .00000   738.05610      .00000  657.57608    8.

     .00726    -.02527    -.01173     .04708      .01624    -.08121    -.01833     .12532
     .01892    -.18141    -.01815     .24739      .01521    -.32199    -.01224     .40111
    -.00388    -.62777     .00605     .76882      .01346    -.77637    -.00755     .62339
    -.01450    -.35342     .04819     .07113     -.05965     .12703     .04942    -.21073
1975.168     19.00000   51.00000      .00000   954.35610      .00000  657.57608    8.

     .00752    -.02584    -.01087     .04762      .01413    -.08024    -.01731     .12394
     .01996    -.18168    -.01998     .24910      .01755    -.32524    -.01410     .40434
    -.00760    -.63466    -.00065     .77815      .00807    -.78543    -.00522     .62873
    -.01382    -.35327     .04540     .06565     -.05653     .13476     .04600    -.21864
1975.168     20.00000   12.00000      .00000   475.55610      .00000  657.57608    8.


    -.00248    -.01162     .00020     .02241      .00210    -.03699    -.00610     .05148
     .00700    -.07060    -.00711     .09156      .00283    -.11734     .00166     .14438
     .01232    -.23190    -.02523     .29036      .03404    -.29370    -.04717     .24687
     .04390    -.16038    -.02055     .04924      .00483     .03279     .00452    -.07307
1975.168     19.00000   30.00000      .00000   739.41860     5.70200 1063.42459    3.

    -.00327    -.01088     .00144     .02072      .00075    -.03427    -.00471     .04803
     .00580    -.06628    -.00623     .08618      .00299    -.11124     .00011     .13801
     .00832    -.22570    -.01821     .28724      .02576    -.29313    -.04051     .24852
     .04093    -.16250    -.02117     .05121      .00754     .03186     .00107    -.07300
1975.168     19.00000   51.00000      .00000   955.71860     5.70200 1063.42459    3.

    -.00270    -.01065     .00106     .02048      .00120    -.03402    -.00502     .04807
     .00629    -.06631    -.00699     .08661      .00437    -.11222    -.00111     .13937
     .00707    -.22751    -.02074     .29013      .03647    -.29619    -.06011     .24965
     .06721    -.16020    -.04892     .04628      .02954     .03769    -.01051    -.07783
1975.168     20.00000   12.00000      .00000   476.91860     5.70200 1063.42459    3.
```

Table B-1 (continued)

```
FIELD SITE: NAVOBSY,BASELINE    STATION: CAROLINA BEACH    XMTR: 19

    .01045    -.02715    -.01738      .05700      .02407    -.10266    -.02976     .16388
    .03219    -.23990    -.02978      .32576      .02060    -.41844    -.00346     .50779
    .05006    -.72699    -.13691      .80529      .17576    -.72157    -.12538     .44608
    .00974    -.08531     .10562     -.15318     -.14391     .19116     .07930    -.11081
1975.154    19.00000   27.00000      .00000   443.93800     .00000  544.24396   16.

    .01112    -.02855    -.01824      .05870      .02665    -.10743    -.03382     .17276
    .03728    -.25469    -.03509      .34596      .02552    -.44388    -.00915     .53802
    .04551    -.76478    -.13662      .83825      .17635    -.74897    -.12305     .46771
    .00946    -.09767     .10330     -.14727     -.13803     .18649     .07255    -.10648
1975.154    21.00000    9.00000      .00000   203.63800     .00000  544.24396   16.

    .01036    -.02807    -.01862      .05877      .02665    -.10778    -.03391     .17255
    .03754    -.25530    -.03461      .34531      .02584    -.44428    -.00908     .53796
    .04761    -.76215    -.13940      .83491      .17935    -.74617    -.12242     .46933
    .00317    -.10536     .11443     -.13623     -.15325     .17462     .08710    -.10087
1975.154    22.00000   43.00000      .00000   344.33800     .00000  544.24396   16.


    .00842    -.02550    -.01385      .05326      .01799    -.09463    -.02159     .15010
    .02208    -.21796    -.01889      .29481      .01020    -.37725     .00484     .45739
    .04872    -.65429    -.12391      .72605      .15545    -.64871    -.10610     .39722
    .00027    -.07115     .09715     -.14600     -.12619     .17983     .0667[illegible]    -.10523
1975.154    19.00000   27.00000      .00000   443.94250    4.42400  544.24396   16.

    .00825    -.02809    -.01228      .05614      .01583    -.10150    -.01713     .15956
    .01501    -.23341    -.00736      .31384     -.00574    -.40058     .02523     .48350
    .07966    -.68361    -.16687      .74904      .19796    -.66564    -.13677     .41327
    .01583    -.08396     .09537     -.13514     -.12838     .17069     .06718    -.10047
1975.154    21.00000    9.00000      .00000   203.64260    4.42400  544.24396   16.

    .00741    -.02725    -.01230      .05578      .01583    -.10029    -.01748     .15866
    .01576    -.23187    -.00860      .31259     -.00394    -.39964     .02425     .48274
    .07851    -.67936    -.16422      .74475      .19392    -.66272    -.13095     .41375
    .00594    -.09086     .10581     -.12460     -.14006     .16031     .07914    -.09482
1975.154    22.00000   43.00000      .00000   344.34260    4.42400  544.24396   16.
```

Table B-1 (concluded)

```
FIELD SITE: NAVOBSY,BASELINE    STATION: CAROLINA BEACH    XMTR: 19

      .01306     -.02176     -.02458      .05206      .03400     -.09827     -.04180      .16117
      .04288     -.23767     -.03637      .32216      .02153     -.41055      .00401      .49200
      .07071     -.67323     -.17612      .71869      .20903     -.63005     -.13200      .40220
     -.00645     -.10829      .12457     -.09265     -.16382      .13322      .10107     -.08154
  1975.188     17.00000    34.00000      .00000   183.23630      .00000   544.24396    17.

      .01292     -.02133     -.02407      .05155      .03357     -.09665     -.04070      .15945
      .04076     -.23360     -.03384      .31745      .01836     -.40294      .00717      .48332
      .07503     -.65997     -.17886      .70646      .21180     -.62382     -.13502      .40485
     -.00149     -.12052      .11622     -.07634     -.15721      .11845      .09679     -.07422
  1975.188     17.00000    57.00000      .00000   651.83630      .00000   544.24396    17.

      .01328     -.02253     -.02436      .05281      .03481     -.09981     -.04261      .16371
      .04404     -.24146     -.03757      .32767      .02182     -.41686      .00333      .50004
      .07212     -.68497     -.17941      .73370      .21513     -.64902     -.14044      .42102
      .00344     -.12296      .11593     -.08222     -.15885      .12560      .09893     -.07793
  1975.188     18.00000    23.00000      .00000   456.23630      .00000   544.24396    17.


      .01241     -.02309     -.02270      .05309      .03114     -.09936     -.03801      .16146
      .03940     -.23747     -.03402      .32147      .02079     -.40927      .00148      .49171
      .06332     -.67463     -.16240      .72134      .19159     -.63510     -.11619      .40248
     -.01367     -.09956      .12375     -.10489     -.15546      .14146      .08930     -.08785
  1975.188     17.00000    34.00000      .00000   183.24370     7.34200   544.24396    16.

     -.00452      .00847      .01133     -.02426     -.01920      .05518      .02588     -.10121
     -.02753      .16360      .02383     -.23766     -.01245      .32128     -.00715     -.40470
     -.06978      .61472      .18260     -.70006     -.24595      .66213      .19350     -.48993
     -.05951      .20786     -.08407      .03336      .15674     -.12156     -.12364      .09533
  1975.188     17.00000    57.00000      .00000   651.83880     7.34200   544.24396    16.

      .01267     -.02407     -.02292      .05424      .03195     -.10138     -.03899      .16429
      .04060     -.24183     -.03582      .32759      .02185     -.41677     -.00008      .50115
      .06272     -.68840     -.16379      .73861      .19615     -.65638     -.12412      .42330
     -.00467     -.11476      .11660     -.09483     -.15121      .13461      .08687     -.08525
  1975.188     18.00000    23.00000      .00000   456.24370     7.34200   544.24396    16.
```

Table B-2

Nominal Time of Measurement Triggers from Start of Pulse

Measurement Number	Time (μs)
1	5
2	7.5
3	10
4	12.5
5	15
6	17.5
7	20
8	22.5
9	25
10	27.5
11	30
12	32.5
13	35
14	37.5
15	40
16	42.5
17	50
18	57.5
19	65
20	72.5
21	80
22	87.5
23	95
24	102.5
25	110
26	117.5
27	125
28	132.5
29	140
30	147.5
31	155
32	162.5

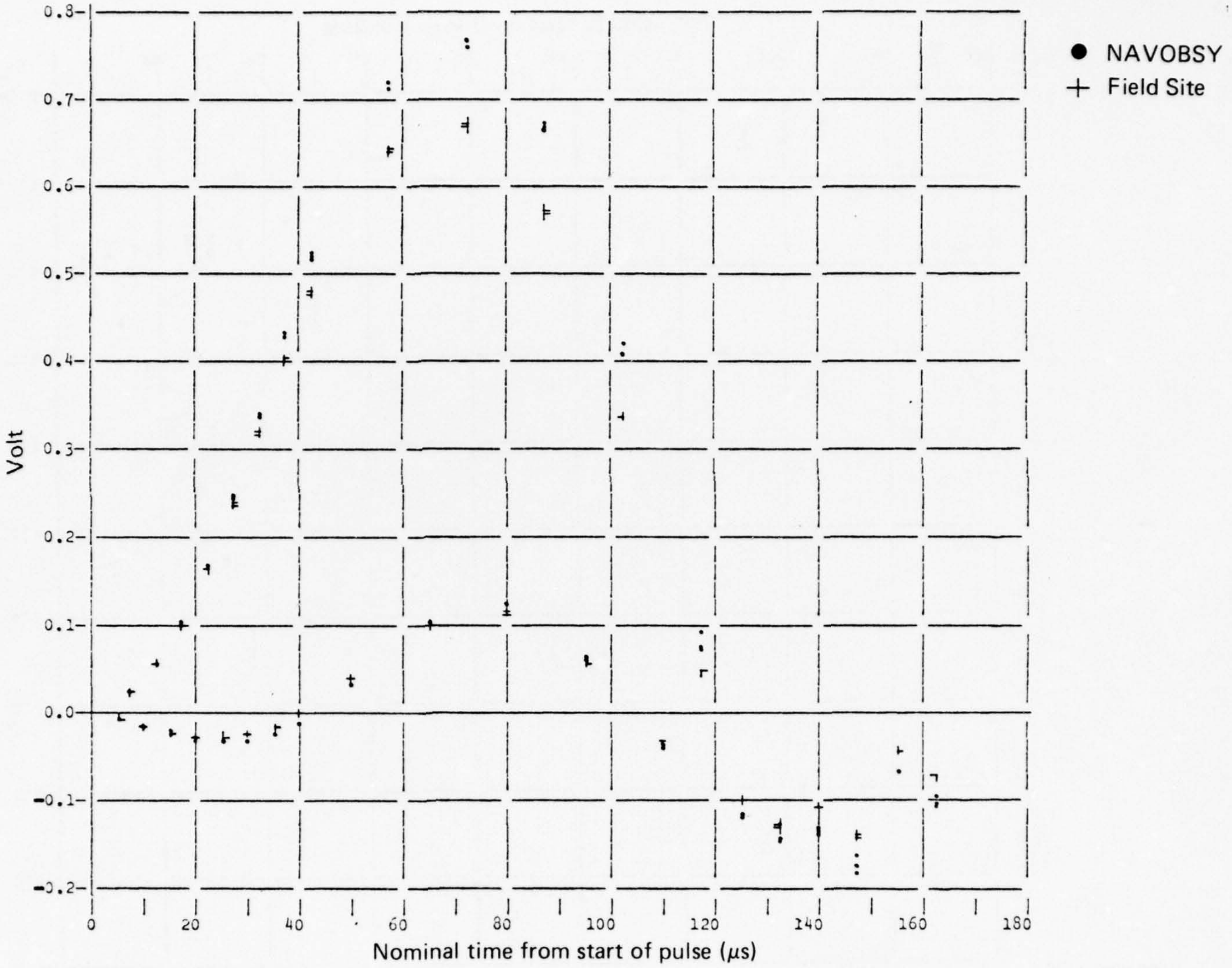


Fig. B-1 Observations of Loran-C Pulse at Wilmington, NC, and NAVOBSY

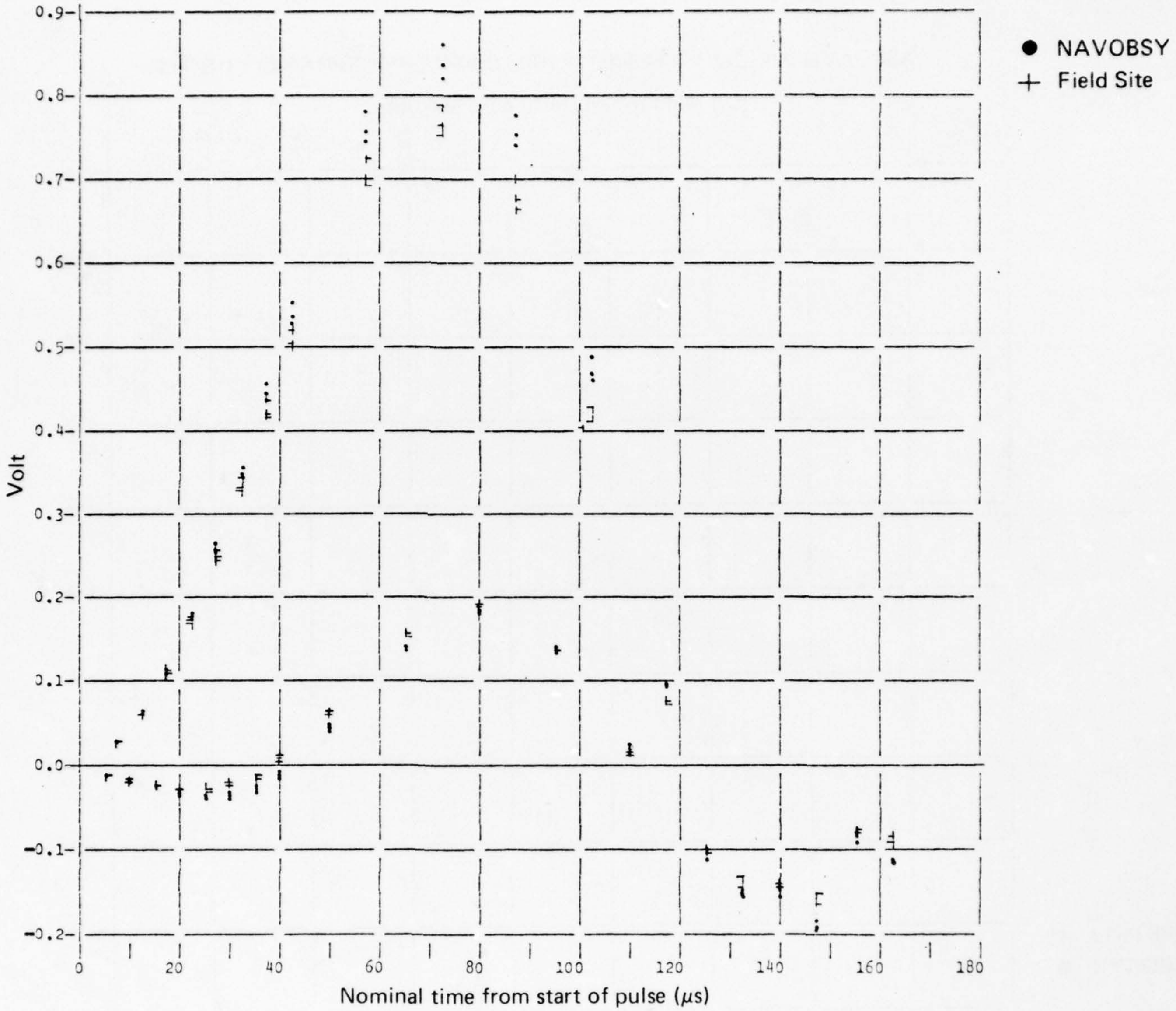


Fig. B-2 Observations of Loran-C Pulse at Emporia, VA, and NAVOBSY

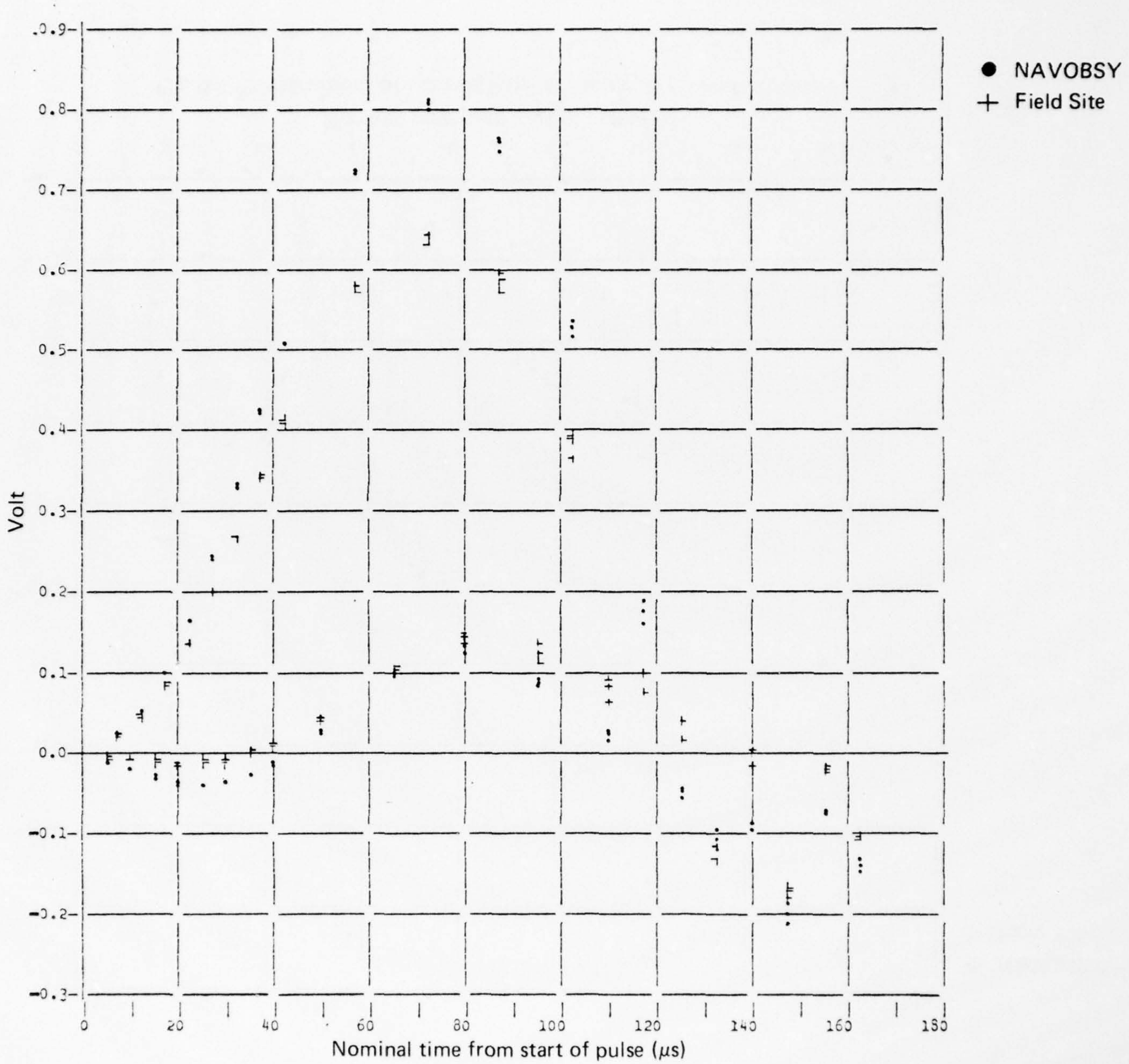


Fig. B-3 Observations of Loran-C Pulse at Towanda, PA, and NAVOBSY

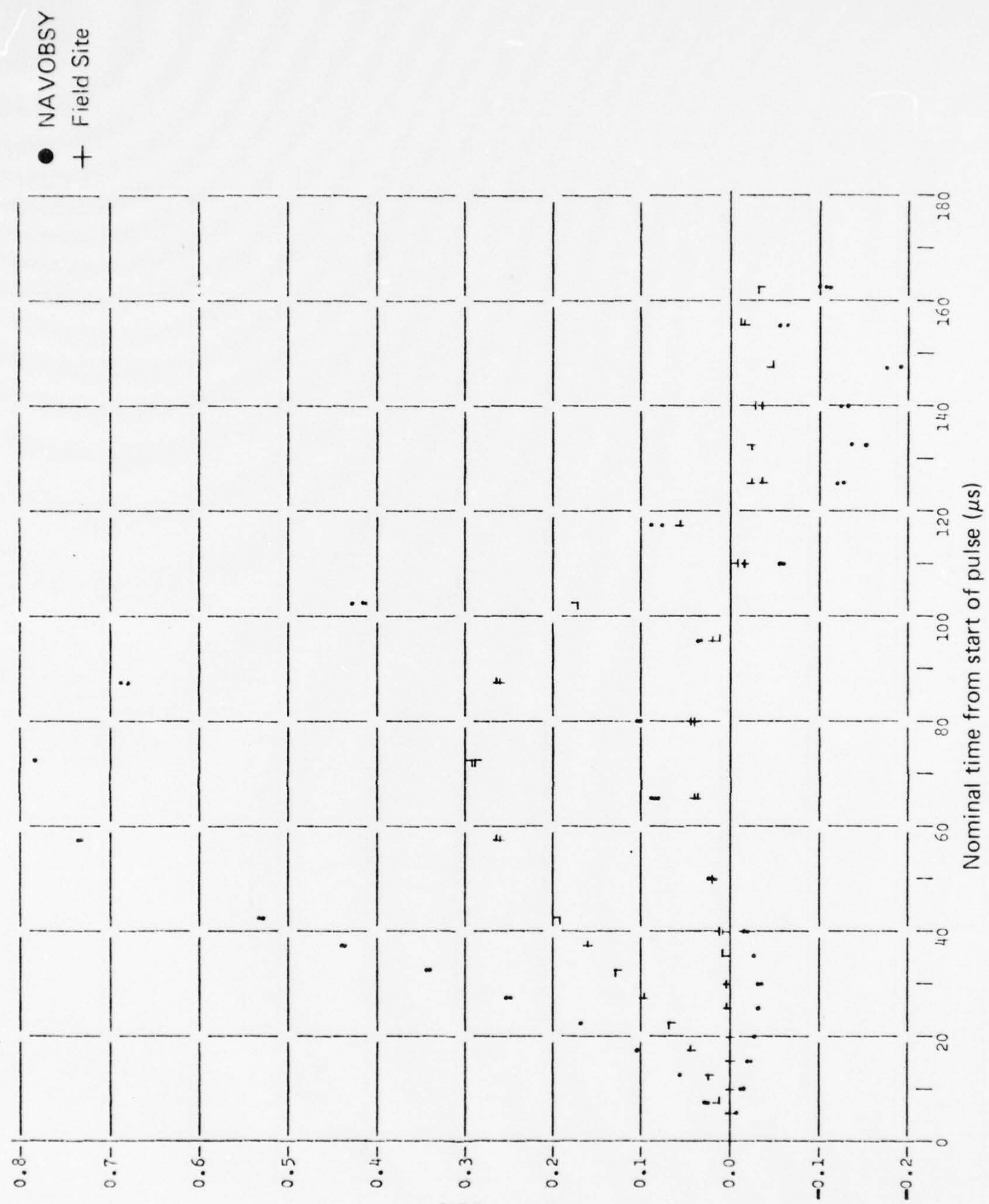


Fig. B-4 Observations of Loran-C Pulse at Dexter, NY, and NAVOBSY

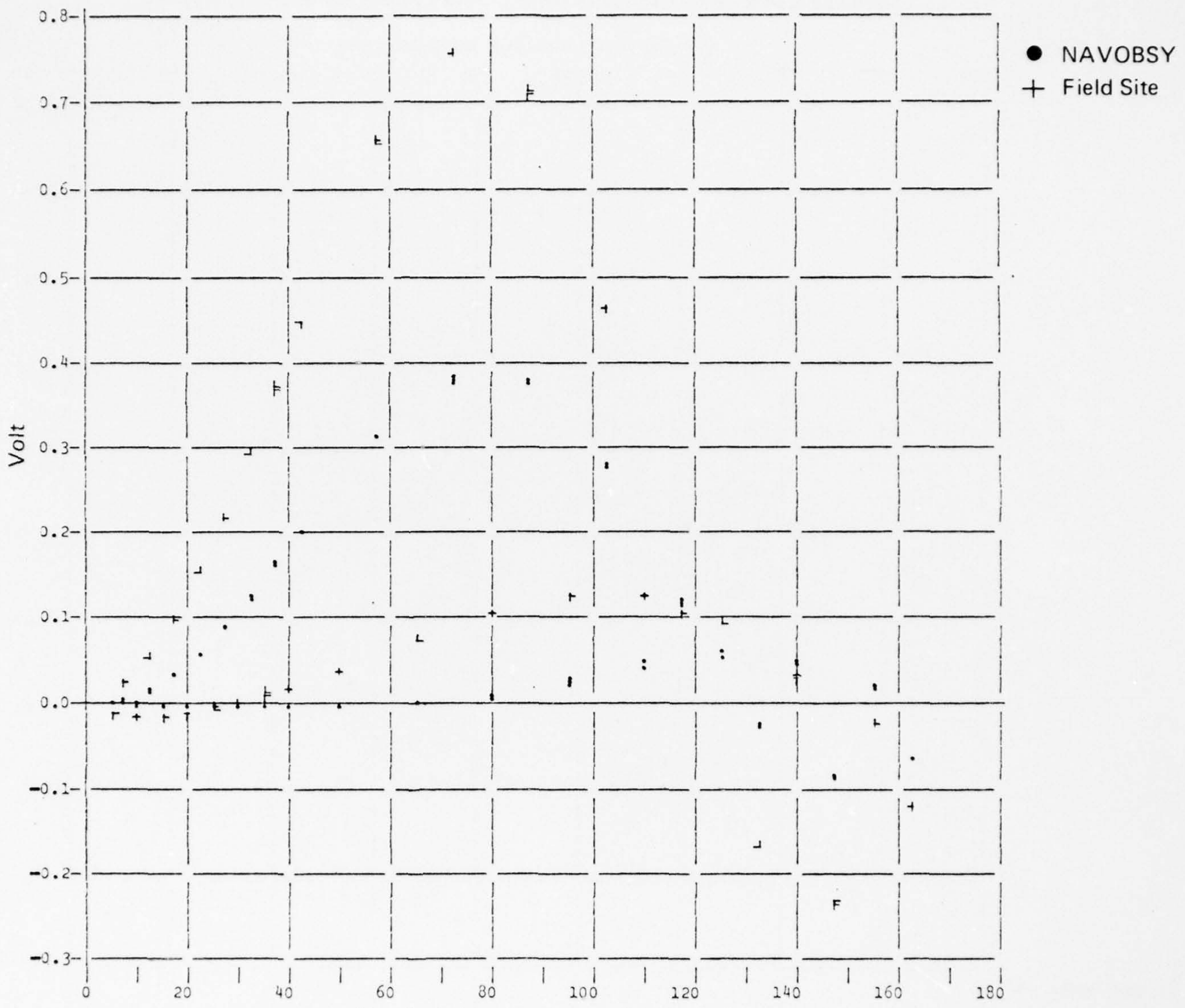


Fig. B-5 Observations of Loran-C Pulse at Danville, IN, and NAVOBSY

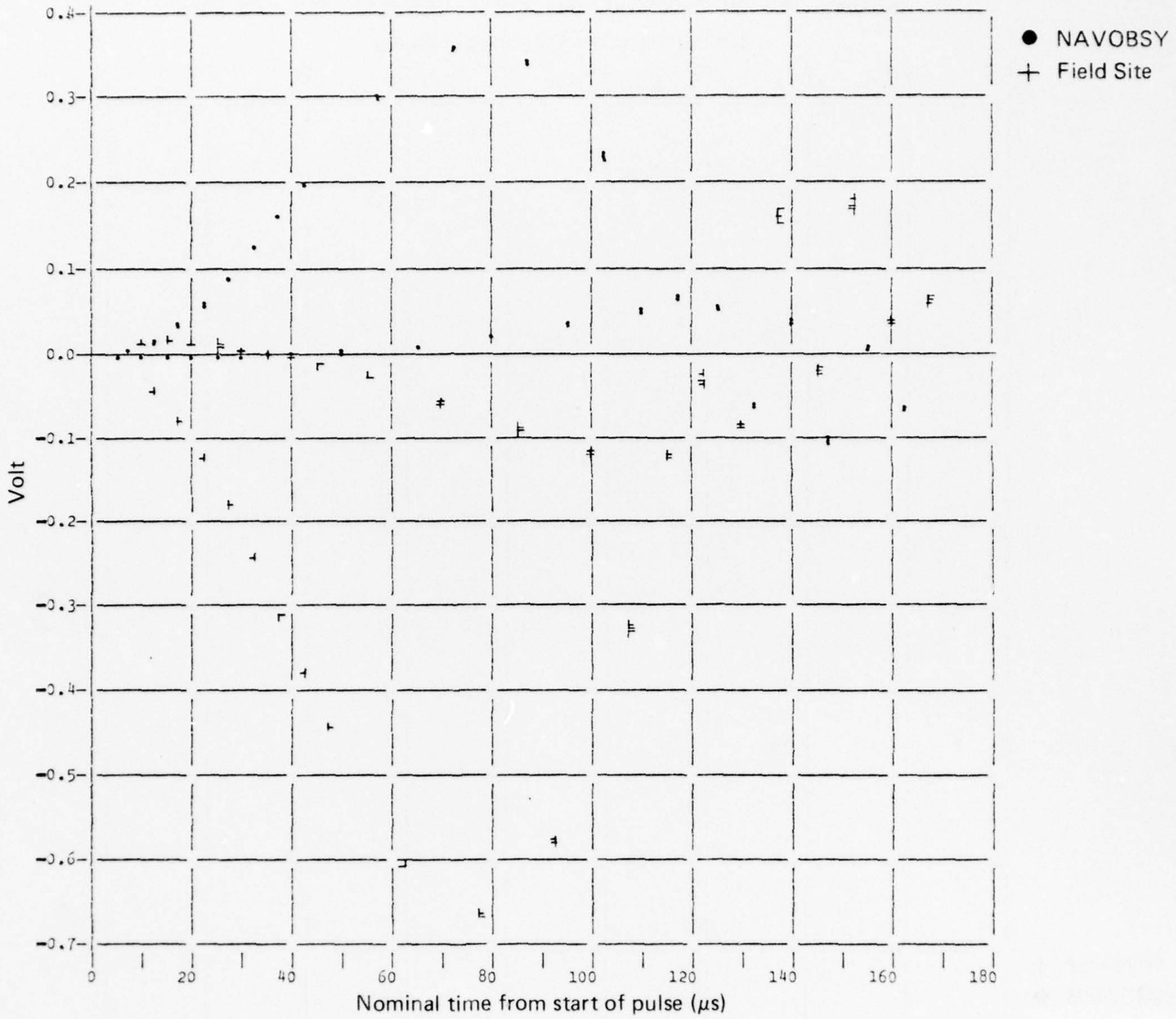


Fig. B-6 Observations of Loran-C Pulse at Marietta, OH, and NAVOBSY

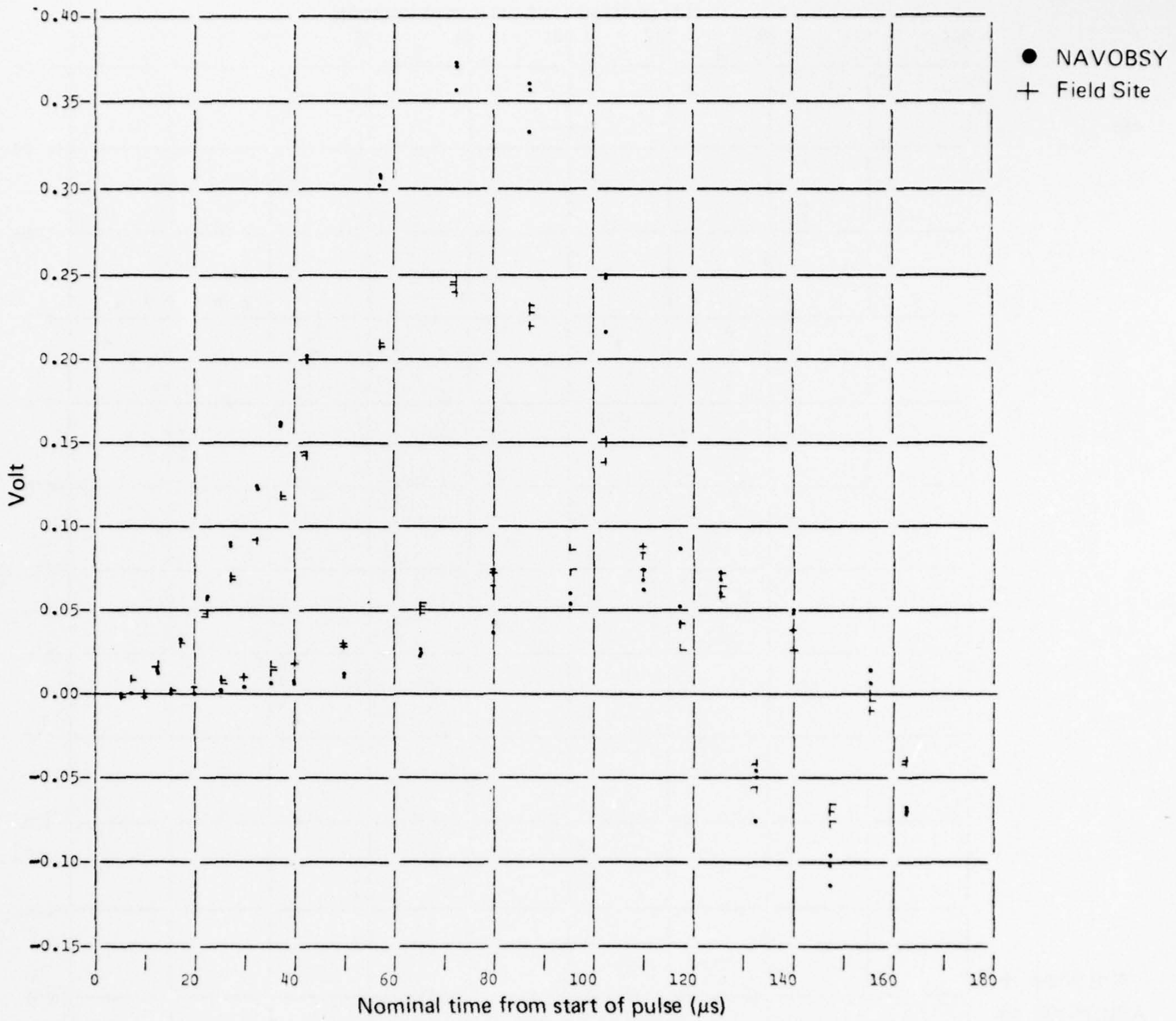


Fig. B-7 Observations of Loran-C Pulse at Georgetown, DE, and NAVOBSY

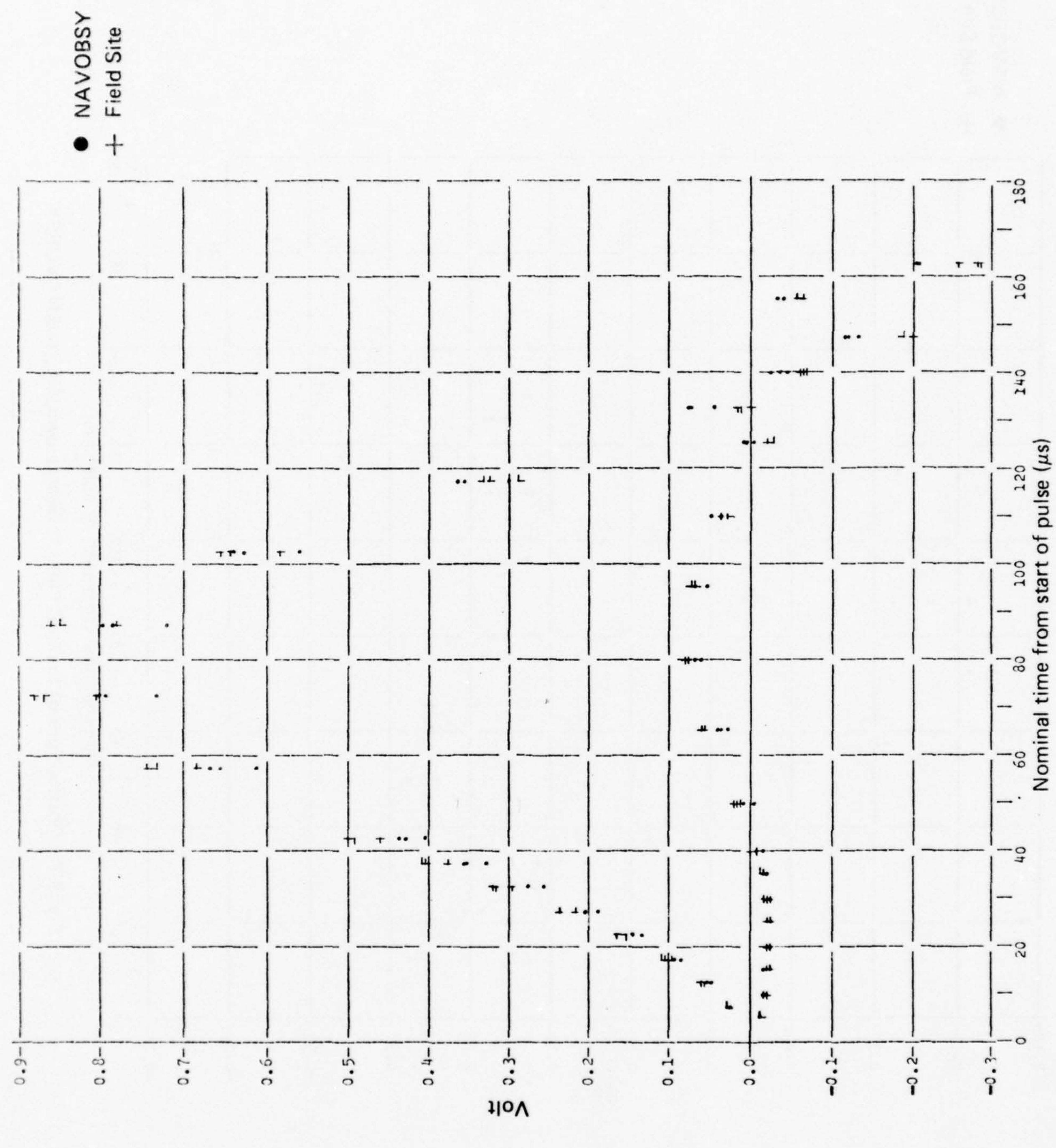


Fig. B-8 Observations of Loran-C Pulse at Toms River, NJ, and NAVOBSY

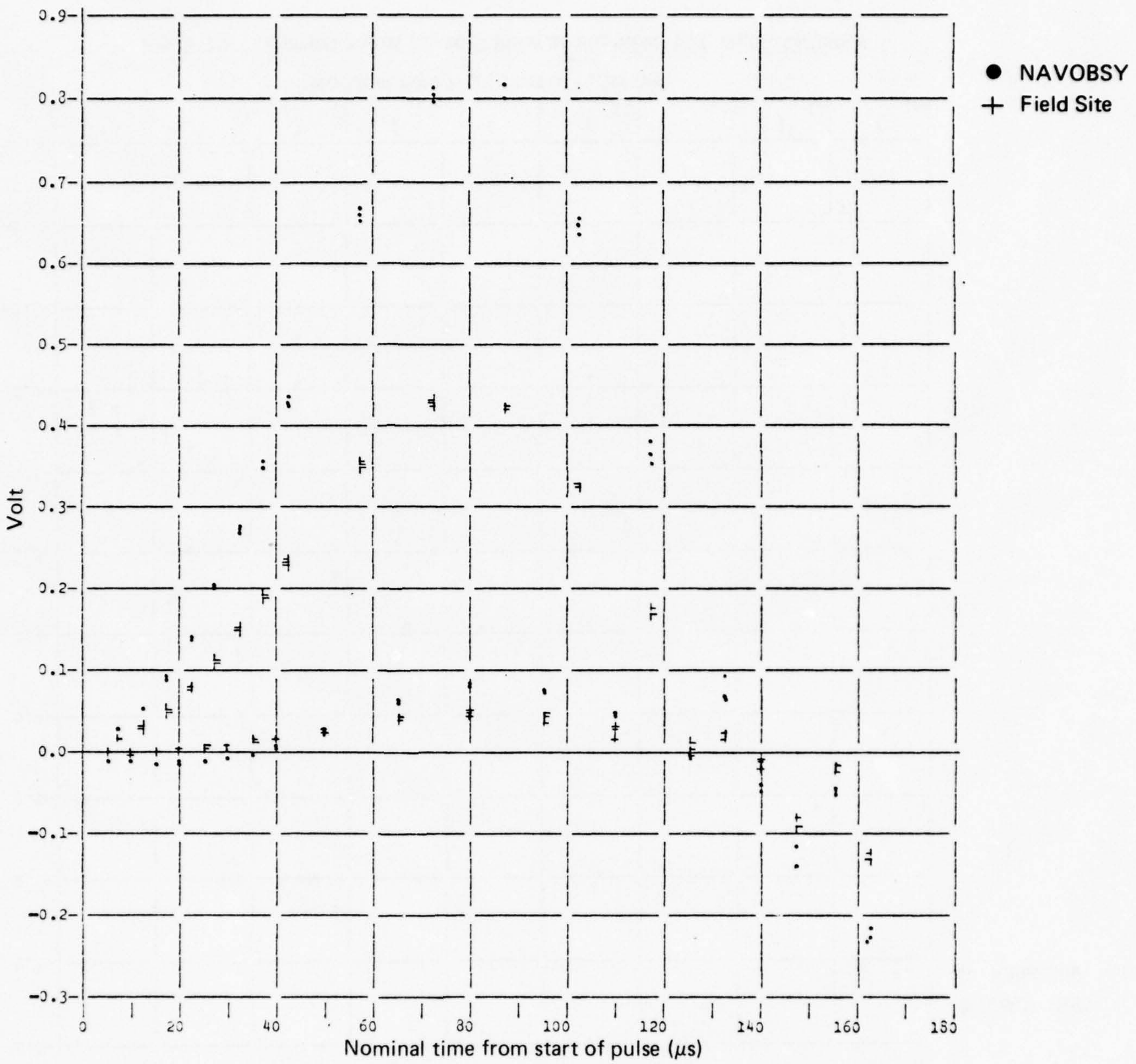


Fig. B-9 Observations of Loran-C Pulse at Grottoes, VA, and NAVOBSY

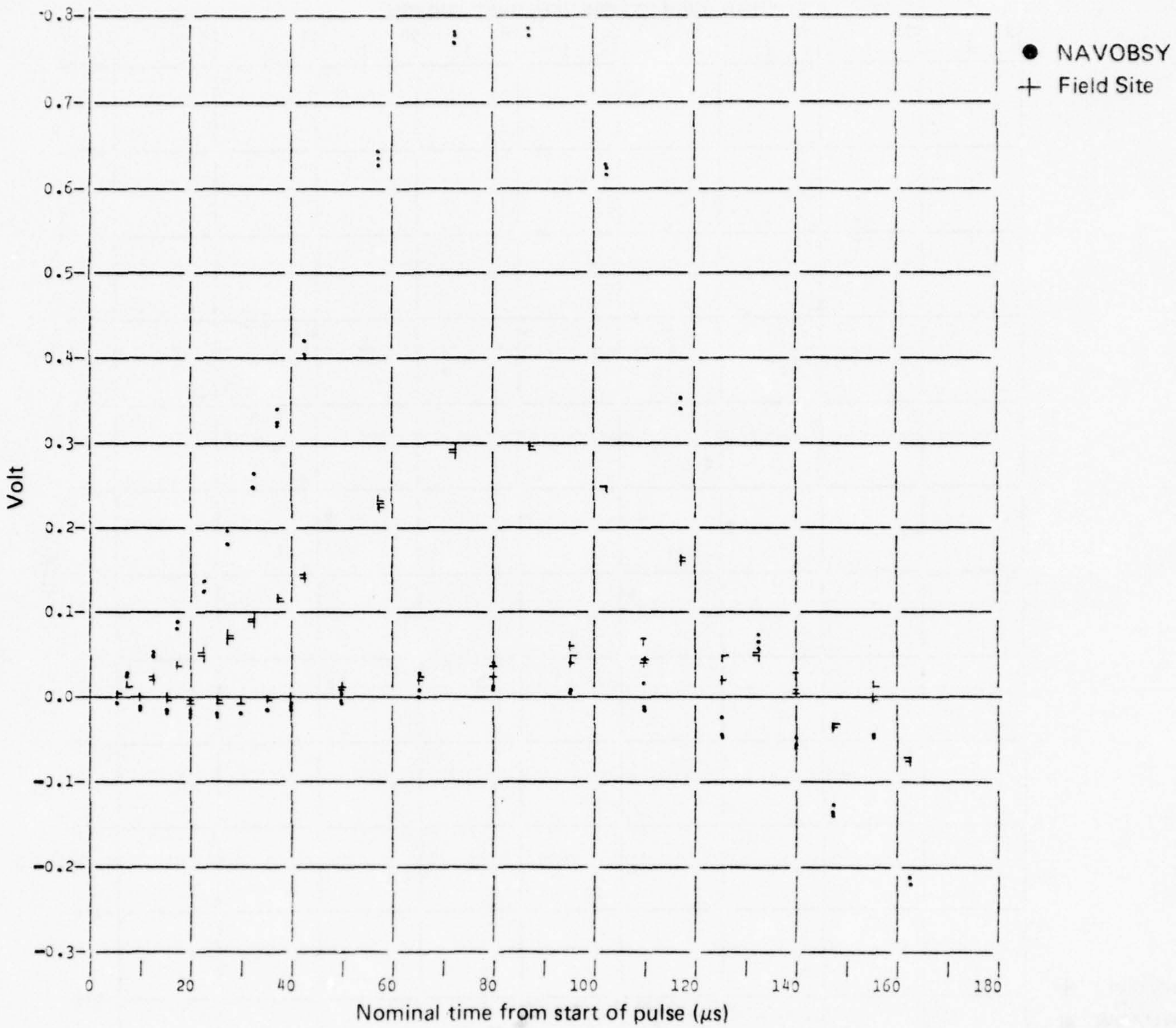


Fig. B-10 Observations of Loran-C Pulse at Bluefield, WV, and NAVOBSY

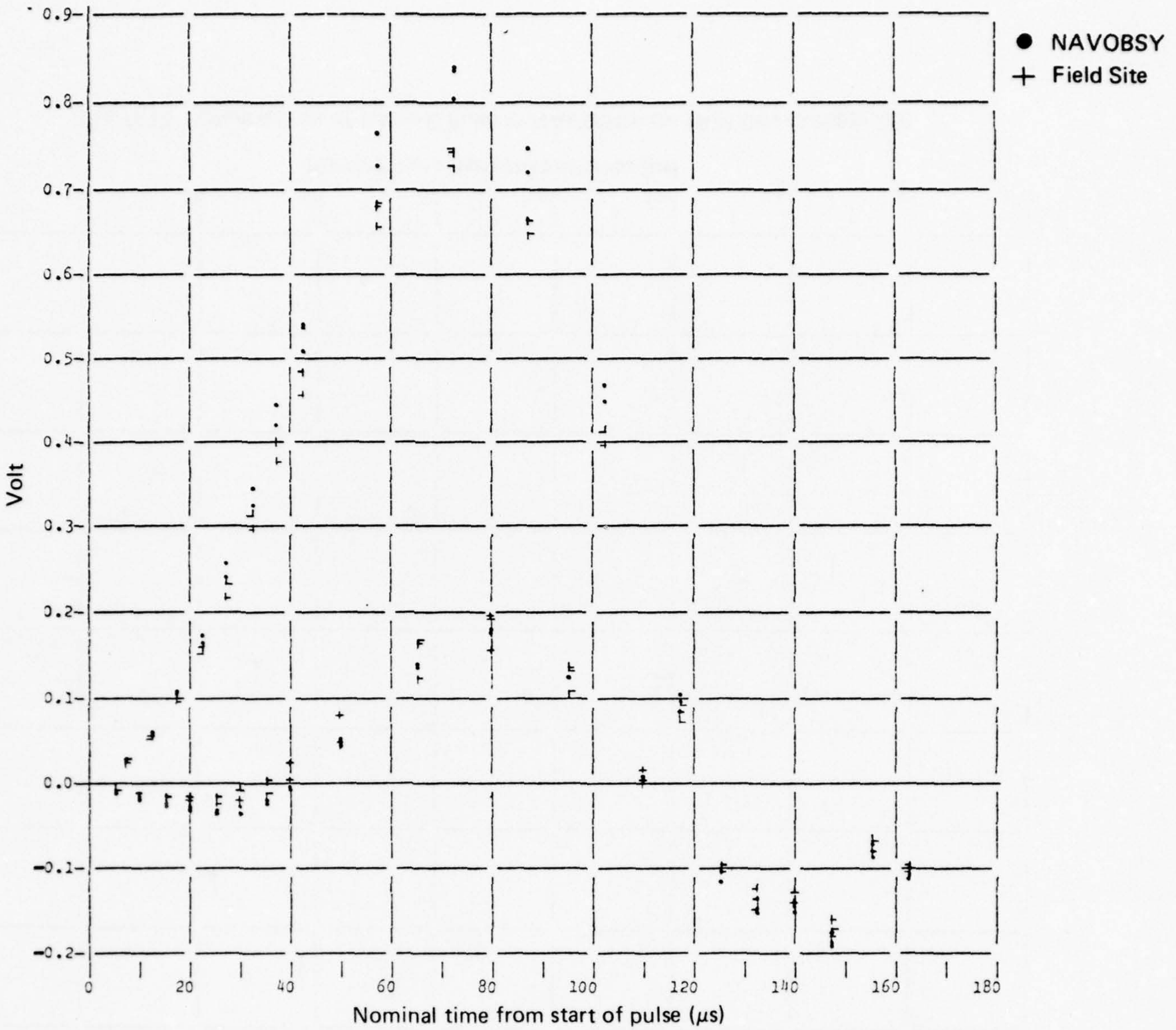


Fig. B-11 Observations of Loran-C Pulse at NAVOBSY on 1975 Day Number 154

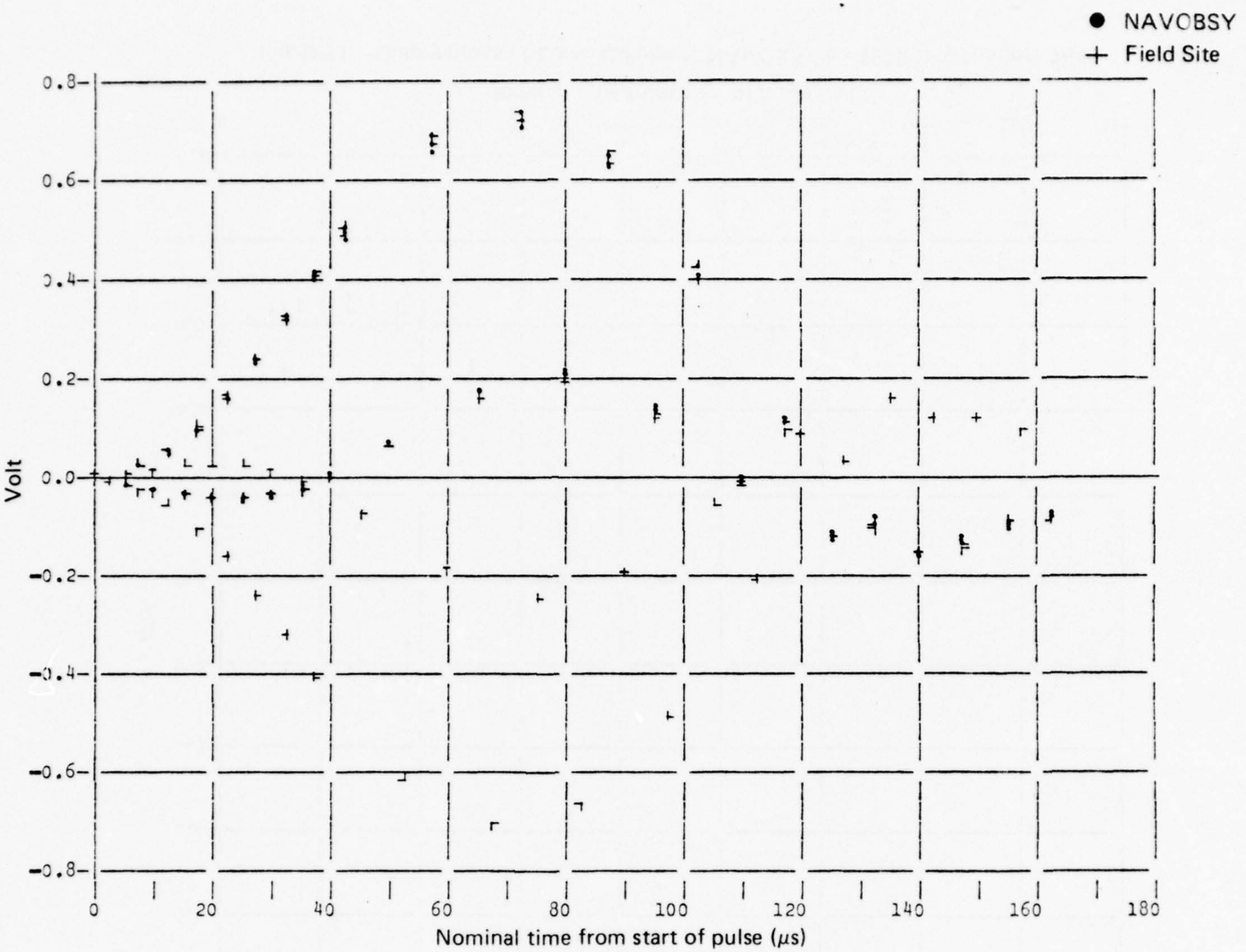


Fig. B-12 Observations of Loran-C Pulse at NAVOBSY on 1975 Day Number 188

Table B-3

Signal-to-Noise Ratio of the Primary Data from
Measurements at the 12th Sample Point

1975 Day No.	Site	Transmitting Station	Station to Site (m)	Edited Data Stage 1 S/N(dB)	Edited Data Stage 2 S/N(dB)
177	Wilmington, NC	Carolina Beach	23572	32	34
177	NAVOBSY	Carolina Beach	544244	21	24
175	Emporia, VA	Carolina Beach	293344	30	33
175	NAVOBSY	Carolina Beach	544244	23	26
183	Towanda, PA	Carolina Beach	867731	10	11
183	NAVOBSY	Carolina Beach	544244	19	23
181	Dexter, NY	Carolina Beach	1113946	21	23
181	NAVOBSY	Carolina Beach	544244	18	18
163	Danville, IN	Dana	85946	32	34
163	NAVOBSY	Dana	903083	7	9
161	Marietta, OH	Dana	526905	30	32
161	NAVOBSY	Dana	903083	8	9
156	Georgetown, DE	Dana	1053517	3	8
156	NAVOBSY	Dana	903083	4	8
149	Toms River, NJ	Nantucket	384346	22	27
149	NAVOBSY	Nantucket	657576	6	9
170	Grottoes, VA	Nantucket	827590	8	15
170	NAVOBSY	Nantucket	657576	13	20
168	Bluefield, WV	Nantucket	1063425	7	11
168	NAVOBSY	Nantucket	657576	14	16

Appendix C

PROGRAMS FOR ANALYSIS OF DATA

This appendix presents the computer programs that were used in the analysis of the data. These programs are written in a computer language known as APL (A Programming Language). See Refs. C-1 and C-2 for the exact interpretation of the language as executed on the Laboratory's IBM 360/91 computer. The program entitled TFIT fits a polynomial to the data of Appendix B by the least squares criterion. The remaining programs are straightforward algebraic manipulation and plotting routines. One of these, SLEW, requires elaboration.

As mentioned in the main text under "Analysis," the polynomials fitted to the I and Q data were jointly adjusted so that the Q polynomial represented a condition of minimum energy. This adjustment is arrived at as follows:

$$V(t) = I(t) \sin \omega t + Q(t) \cos \omega t, \qquad \text{(C-1)}$$

where $V(t)$ is the voltage function,
$I(t)$ is the in-phase modulation,
$Q(t)$ is the in-quadrature modulation,
ω is the angular frequency corresponding to 100 kHz, and
t is time.

The problem is to find an adjustment, Δt, of the sample points in time that results in minimum energy in $Q(t)$.

Introduce Δt into Eq. (C-1).

$$V(t+\Delta t)=I(t+\Delta t) \sin \omega (t+\Delta t)+Q(t+\Delta t) \cos \omega (t+\Delta t). \text{(C-2)}$$

Rewrite Eq. (C-2) as

$$V(t+\Delta t) = I(t+\Delta t)(\sin \omega t \cos \omega\Delta t+\cos \omega t \sin \omega\Delta t)$$

$$+ Q(t+\Delta t)(\cos \omega t \cos \omega\Delta t-\sin \omega t \sin \omega\Delta t). \qquad \text{(C-3)}$$

Rearranging terms, Eq. (C-3) becomes

$$V(t+\Delta t) = (I(t+\Delta t)\cos\omega\Delta t - Q(t+\Delta t)\sin\omega\Delta t)\sin\omega t$$

$$+ (Q(t+\Delta t)\cos\omega\Delta t + I(t+\Delta t)\sin\omega\Delta t)\cos\omega t. \quad (C\text{-}4)$$

The energy proportional to that of the cosine modulation is observed to be

$$EQ(t + \Delta t) = \int_{t_1+\Delta t}^{t_2+\Delta t} Q^2(t + \Delta t)\cos^2\omega\Delta t\, dt$$

$$+ 2\int_{t_1+\Delta t}^{t_2+\Delta t} Q(t + \Delta t)\, I(t + \Delta t)\cos\omega\Delta t\sin\omega\Delta t\, dt$$

$$+ \int_{t_1+\Delta t}^{t_2+\Delta t} I^2(t + \Delta t)\sin^2\omega\Delta t\, dt\ . \qquad (C\text{-}5)$$

Since the energy in the sine modulation as measured is large with respect to the cosine due to the locations of the samples on the pulse, it can be expected that a solution for Δt will produce very small values. By comparison, the interval over which Eq. (C-5) is to be integrated is arbitrarily large. Therefore, a reasonably accurate solution for Δt corresponding to minimum energy in the cosine modulation can be obtained by letting $t+\Delta t=t$ in Eq. (C-5), and then taking the partial derivative of EQ(t) with respect to Δt and setting it equal to zero. Thus,

$$\sin 2\,\omega\Delta t \int_{t_1}^{t_2} I^2(t)\,dt - \sin 2\,\omega\Delta t \int_{t_1}^{t_2} Q^2(t)\,dt$$

$$+ 2\cos 2\,\omega\Delta t \int_{t_1}^{t_2} Q(t)\,I(t)\,dt = 0\ , \tag{C-6}$$

and

$$\Delta t = \frac{1}{2\omega}\tan^{-1}\frac{2\displaystyle\int_{t_1}^{t_2} Q(t)\,I(t)\,dt}{\displaystyle\int_{t_1}^{t_2} Q^2(t)\,dt - \int_{t_1}^{t_2} I^2(t)\,dt}\ . \tag{C-7}$$

SLEW executes Eq. (C-7) to find Δt.

APL PROGRAMS

The program CASES calls the program TFIT to fit polynomials to sets of data identified by JMIN through JMAX.

```
      ∇CASES[⎕]∇
    ∇ CASES
[1]   J←JMIN
[2]   →CLEAR×⍳WHICH='Q'
[3]   ICT←((D-1),0)⍴0
[4]   STARTI←SDI←BIGI←MUI←⍳0
[5]   →DO
[6]  CLEAR:QCT←((D-1),0)⍴0
[7]   STARTQ←SDQ←BIGQ←MUQ←⍳0
[8]  DO:→0×⍳J=JMAX
[9]   J←J+1
[10]  TFIT
[11]  →SAVQ×⍳WHICH='Q'
[12]  SAVEI
[13]  →DO
[14] SAVQ:SAVEQ
[15]  →DO
    ∇
```

CASES also calls SAVEQ or SAVEI, depending on whether Q or I data are fitted. SAVEQ and SAVEI arrange the results of TFIT in suitable arrays.

```
      ∇SAVEQ[⎕]∇
    ∇ SAVEQ
[1]   QCT←QCT,QC
[2]   MUQ←MUQ,¯1↑MEAN
[3]   BIGQ←BIGQ,¯1↑MAX
[4]   SDQ←SDQ,¯1↑SIG
[5]   STARTQ←STARTQ,T0
    ∇
```

```
      ∇SAVEI[⎕]∇
    ∇ SAVEI
[1]   ICT←ICT,IC
[2]   MUI←MUI,¯1↑MEAN
[3]   BIGI←BIGI,¯1↑MAX
[4]   SDI←SDI,¯1↑SIG
[5]   STARTI←STARTI,T0
    ∇
```

The program TFIT fits a polynomial by least squares to a set of either Q or I data identified by J. The degree of the polynomial, D, must be at least 2. The first two coefficients of the polynomial (ascending order of degree) are set to zero.

```
      ∇TFIT[⎕]∇
    ∇ TFIT
[1]     ΔT←T0←K←LL←NN←0
[2]     L←2
[3]     N←1
[4]     MAX←MEAN←SIG←⍳0
[5]    DO:→0×⍳(L>12)+(N>11)
[6]     K←K+1
[7]     →Q×⍳WHICH='Q'
[8]     IT←0.1×(-T0)+(2.5+5×⍳8),
        42.5+15×⍳8
[9]     IC←ID[;,J]⌹IT∘.*1↓⍳D
[10]    RES←((IT∘.*1↓⍳D)+.×,IC)-ID[;J]
[11]    →MORE
[12]  Q:QT←0.1×(-T0)+(5×⍳8),35+15×⍳8
[13]    QC←QD[;,J]⌹QT∘.*1↓⍳D
[14]    RES←((QT∘.*1↓⍳D)+.×,QC)-QD[;J]
[15]  MORE:MAX←MAX,1↑RES[⍒|RES]
[16]    MEAN←MEAN,(+/RES)÷⍴RES
[17]    SIG←SIG,((+/(RES-MEAN[K])*2)÷((⍴RES)-D-1))*
        0.5
[18]    →SKIP×⍳K≠1
[19]    T0←T0+ΔT←1
[20]    →DO
[21]  SKIP:→(SKIP1×SIG[K-1×ΔT>0]>SIG[K-1×ΔT<0])+
        SKIP2×SIG[K-1×ΔT>0]<SIG[K-1×ΔT<0]
[22]  SKIP1:N←N+LL
[23]    LL←0
[24]    NN←2
[25]    T0←T0+ΔT←1÷2*L
[26]    →DO
[27]  SKIP2:L←L+NN
[28]    NN←0
[29]    LL←2
[30]    T0←T0+ΔT←-1÷2*N
[31]    →DO
    ∇
```

The program TRANS1 translates the polynomials produced by TFIT to rereference time by a time increment, TO, which is determined iteratively by TFIT to obtain the best fit.

```
      ∇TRANS1[⎕]∇
    ∇ TRANS1
[1]    K←0
[2]   DO:→0×⍳K=ELE
[3]    K←K+1
[4]    ITVP[;K]←(-0.1×(VAN/STARTI)[K]) TRP ITVP[;K]
[5]    QTVP[;K]←(-0.1×(VAN/STARTQ)[K]) TRP QTVP[;K]
[6]    ITOP[;K]←(-0.1×(OBS/STARTI)[K]) TRP ITOP[;K]
[7]    QTOP[;K]←(-0.1×(OBS/STARTQ)[K]) TRP QTOP[;K]
[8]    →DO
    ∇
```

The program TRANS2 translates the polynomials produced by SLEW to rereference time by the time increments, ΔTV and ΔTO, which is determined by SLEW to achieve minimum energy in Q.

```
      ∇TRANS2[⎕]∇
    ∇ TRANS2
[1]    K←0
[2]   DO:→0×⍳K=ELE
[3]    K←K+1
[4]    ITVS[;K]←(ΔTV[K]÷10) TRP ITVR[;K]
[5]    QTVS[;K]←(ΔTV[K]÷10) TRP QTVR[;K]
[6]    ITOS[;K]←(ΔTO[K]÷10) TRP ITOR[;K]
[7]    QTOS[;K]←(ΔTO[K]÷10) TRP QTOR[;K]
[8]    →DO
    ∇
```

The program SLEW executes Eq. (C-7) to produce polynomials that describe the condition of minimum energy in the cosine modulation.

```
       ∇SLEW[⎕]∇
     ∇ SLEW
[1]    L← 1 7
[2]    QCO←QTOP
[3]    ICO←ITOP
[4]    QCV←QTVP
[5]    ICV←ITVP
[6]    ELE←1↓⍴QCO
[7]    ROW←1↑⍴QCO
[8]    ΔTH←THO←THV←⍳0
[9]    J←0
[10]  DO:→END×⍳J=ELE
[11]   J←J+1
[12]   INT1←L PI ICO[;J] PP QCO[;J]
[13]   INT2←L PI ICO[;J] PP ICO[;J]
[14]   INT3←L PI QCO[;J] PP QCO[;J]
[15]   THO←THO,0.5×¯3○(2×INT1)÷INT3-INT2
[16]   INT1←L PI ICV[;J] PP QCV[;J]
[17]   INT2←L PI ICV[;J] PP ICV[;J]
[18]   INT3←L PI QCV[;J] PP QCV[;J]
[19]   THV←THV,0.5×¯3○(2×INT1)÷INT3-INT2
[20]   →DO
[21]  END:QTVR←(QCV×(ROW,ELE)⍴2○THV)+ICV×(ROW,ELE)⍴1○THV
[22]   ITVR←(-QCV×(ROW,ELE)⍴1○THV)+ICV×(ROW,ELE)⍴2○THV
[23]   QTOR←(QCO×(ROW,ELE)⍴2○THO)+ICO×(ROW,ELE)⍴1○THO
[24]   ITOR←(-QCO×(ROW,ELE)⍴1○THO)+ICO×(ROW,ELE)⍴2○THO
[25]   ΔTV←THV×10÷○2
[26]   ΔTO←THO×10÷○2
[27]   ΔT←ΔTV-ΔTO
     ∇
```

The program ZEROS computes the time of the zero crossings in pulses described by the polynomials produced by TRANS1.

```
       ∇ZEROS[⎕]∇
     ∇ ZEROS
[1]    T←2.25+0.25×⍳321
[2]    DT←T[2]-T[1]
[3]    T←T÷10
[4]    RO←RV←ΔZTO←ΔZTV←ZTO←ZTV←⍳0
[5]    J←0
[6]   DO:→0×⍳J=36
[7]    J←J+1
[8]    CMO←(((⍴T),1)⍴T)⊥⌽QTOP[;J]
[9]    SMO←(((⍴T),1)⍴T)⊥⌽ITOP[;J]
[10]   CMV←(((⍴T),1)⍴T)⊥⌽QTVP[;J]
[11]   SMV←(((⍴T),1)⍴T)⊥⌽ITVP[;J]
[12]   S←1○○2×T
[13]   C←2○○2×T
[14]   LO←(S×SMO)+C×CMO
[15]   LV←(S×SMV)+C×CMV
[16]   ZCTO←ZCTV←⍳0
[17]   JJ←0
[18]  DO3:→SKIP3×⍳JJ=(⍴T)-1
[19]   JJ←JJ+1
[20]   →SKIP×⍳((×LO[JJ])+×LO[JJ+1])≠0
[21]   ZCTO←ZCTO,2.25+(JJ×DT)+(DT×LO[JJ])÷LO[JJ]-LO[JJ+1]
[22]  SKIP:→DO3×⍳((×LV[JJ])+×LV[JJ+1])≠0
[23]   ZCTV←ZCTV,2.25+(JJ×DT)+(DT×LV[JJ])÷LV[JJ]-LV[JJ+1]
[24]   →DO3
[25]  SKIP3:→SAVE×⍳(⍴ZCTO)<17
[26]   ZCTO←1↓ZCTO
[27]  SAVE:ΔZTO←ΔZTO,ZCTO-5×⍳⍴ZCTO
[28]   ZTO←ZTO,ZCTO
[29]   ΔZTV←ΔZTV,ZCTV-5×⍳⍴ZCTV
[30]   ZTV←ZTV,ZCTV
[31]   →DO
     ∇
```

The P in lines 8 through 11 was changed to 3 to compute zero crossings in pulses described by polynomials produced by TRANS3.

The program SLEWZ produces polynomials that describe pulses that have the zero crossing at the end of the third cycle aligned with the 30-μs sample point.

```
      ∇SLEWZ[⎕]∇
    ∇ SLEWZ
[1]   ΔTV←ΔZTV[;6]
[2]   ΔTO←ΔZTO[;6]
[3]   THV←ΔTV÷10÷○2
[4]   THO←ΔTO÷10÷○2
[5]   QCO←QTOP
[6]   ICO←ITOP
[7]   QCV←QTVP
[8]   ICV←ITVP
[9]   ROW←1↑ρQCO
[10]  ELE←1↓ρQCO
[11]  QTVR←(QCV×(ROW,ELE)ρ2○THV)+ICV×(ROW,ELE)ρ1○THV
[12]  ITVR←(-QCV×(ROW,ELE)ρ1○THV)+ICV×(ROW,ELE)ρ2○THV
[13]  QTOR←(QCO×(ROW,ELE)ρ2○THO)+ICO×(ROW,ELE)ρ1○THO
[14]  ITOR←(-QCO×(ROW,ELE)ρ1○THO)+ICO×(ROW,ELE)ρ2○THO
[15]  ΔT←ΔTV-ΔTO
    ∇
```

TRANS3 translates the polynomials produced by SLEWZ to rereference time by the time increments, ΔTV and ΔTO.

```
      ∇TRANS3[⎕]∇
    ∇ TRANS3
[1]   K←0
[2]  DO:→0×⍳K=ELE
[3]   K←K+1
[4]   ITV3[;K]←(ΔTV[K]÷10) TRP ITVR[;K]
[5]   QTV3[;K]←(ΔTV[K]÷10) TRP QTVR[;K]
[6]   ITO3[;K]←(ΔTO[K]÷10) TRP ITOR[;K]
[7]   QTO3[;K]←(ΔTO[K]÷10) TRP QTOR[;K]
[8]   →DO
    ∇
```

The program LORAN evaluates the slewed polynomials that describe the sine and cosine modulation, normalizes the results to unit energy, adjusts the attenuation of the received signal by the amount of the normalization factor, computes the pulse envelope, and plots the results.

```
        ∇LORAN[⎕]∇
      ∇ LORAN
[1]     ROT←0
[2]     T←0.1×2.5+2.5×⍳63
[3]     EQO←(((⍴T),1)⍴T)⊥⌽QTOS[;J]
[4]     EIO←(((⍴T),1)⍴T)⊥⌽ITOS[;J]
[5]     EQV←(((⍴T),1)⍴T)⊥⌽QTVS[;J]
[6]     EIV←(((⍴T),1)⍴T)⊥⌽ITVS[;J]
[7]     NO←(+/(EQO*2)+EIO*2)*0.5
[8]     NV←(+/(EQV*2)+EIV*2)*0.5
[9]     EQO←EQO÷NO
[10]    EIO←EIO÷NO
[11]    EQV←EQV÷NV
[12]    EIV←EIV÷NV
[13]    EO←((EQO*2)+EIO*2)*0.5
[14]    EV←((EQV*2)+EIV*2)*0.5
[15]    BELO←DBO[J]+20×10⍟NO
[16]    BELV←DBV[J]+20×10⍟NV
[17]    →⎕
[18]  ONE:K←0
[19]  DO:WAIT←⍞
[20]    'LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROS
        ECONDS            1975 DAY NO.:', 4 0 ⍕DAY[J]
[21]    'FIELD SITE: ',SITE[J;],'     STATION: ',STA[J;],'    XM
        TR: ',(2 0 ⍕XMTR[J]),'  DATA SEGMENT: ',SEG[J;]
[22]    'ATTENUATION:  ',(6 3 ⍕BELO),' DB AT NAVOBSY,  ',(
        6 3 ⍕BELV),' DB AT FIELD SITE'
[23]    'SECONDARY PHASE FACTOR:  ',(6 3 ⍕SPF[J]),' MICROSECON
        DS'
[24]    ''
[25]    '. ←→NAVOBSY   + ←→FIELD SITE'
[26]    WAIT←⍞
[27]    →SKIP×⍳K=1
[28]    50 120 FPLOT(EIO,EIV,EQO AND EQV) VS T×10
[29]  TWO:K←1
[30]    →DO
[31]  SKIP: 50 120 FPLOT(EO AND EV) VS T×10
      ∇
```

The program EDGE evaluates the polynomials produced by TRANS3 over the leading edge of the pulses, normalizes them to unit energy, and plots the leading edge of the envelope of the pulses.

```
      ∇EDGE[⎕]∇
    ∇ EDGE L
[1]    ROT←0
[2]    T←9+⍳76
[3]    EO←EV←⍳0
[4]    K←0
[5]   DO:→END×⍳K=3
[6]    J←L+K
[7]    K←K+1
[8]    '3' EVAL T
[9]    NVE←((EQV*2)+EIV*2)*0.5
[10]   NOE←((EQO*2)+EIO*2)*0.5
[11]   EO←EO,NOE÷NOE[1↑⍒NOE]
[12]   EV←EV,NVE÷NVE[1↑⍒NVE]
[13]   →DO
[14]  END:WAIT←⍞
[15]   '        LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN
       MICROSECONDS                 1975 DAY NO.:', 4 0 ⍕DAY[J]
[16]   '        FIELD SITE: ',SITE[J;],'     STATION: ',STA[J;],'
          XMTR: ',(2 0 ⍕XMTR[J]),'  DATA SEGMENT:   ALL'
[17]   ''
[18]   '          . ←→NAVOBSY    + ←→FIELD SITE'
[19]   WAIT←⍞
[20]   S←⍴T
[21]   40 120 FPLOT((S↑EO),(S↑EV),(S↓(2×S)↑EO),(S↓(2×S)↑EV),(
       (-S)↑EO) AND(-S)↑EV) VS T,T,(10+T),(10+T),(20+T) AND
       20+T
    ∇
```

EVAL evaluates polynomials identified by A and J at times specified by T.

```
      ∇EVAL[⎕]∇
    ∇ A EVAL T
[1]    EQO←(((⍴T),1)⍴T÷10)⊥⌽(⍎'QTO',A)[;J]
[2]    EIO←(((⍴T),1)⍴T÷10)⊥⌽(⍎'ITO',A)[;J]
[3]    EQV←(((⍴T),1)⍴T÷10)⊥⌽(⍎'QTV',A)[;J]
[4]    EIV←(((⍴T),1)⍴T÷10)⊥⌽(⍎'ITV',A)[;J]
    ∇
```

The program TRP translates any polynomial, P, by a time increment, Δ.

```
      ∇TRP[⎕]∇
    ∇ R←Δ TRP P
[1]   R←(((1-⍳⍴P)⌽((⍴P),(⍴P))⍴Δ*¯1+⍳⍴P)×(¯1+⍳⍴P)∘.!¯1+⍳⍴P)+.×P
    ∇
```

PI integrates any polynomial, P, between limits given by the two-element vector, L.

```
      ∇PI[⎕]∇
    ∇ R←L PI P
[1]   P←P÷⍳⍴P
[2]   R←+/P×((1↓L)*⍳⍴P)-(1↑L)*⍳⍴P
    ∇
```

PP multiplies two polynomials, P1 and P2. They need not be of the same degree.

```
      ∇PP[⎕]∇
    ∇ P←P1 PP P2;D
[1]   P←P1∘.×P2
[2]   D←1↑⍴P
[3]   P←(1-⍳D)⌽P,((D,D-1)⍴0)
[4]   P←+/[1] P
    ∇
```

These programs require P to be arranged in ascending order of degree starting with 0 and all terms must be accounted for.

The program ECM computes the change in ECM, ΔECM, between the field site and NAVOBSY from the polynomials produced by TRANS3.

```
      ∇ECM[⎕]∇
    ∇ ECM
[1]     ΔECM←⍳0
[2]     T←64+⍳21
[3]     J←JMIN
[4]   DO:→0×⍳J=JMAX
[5]     J←J+1
[6]     '3' EVAL T
[7]     NVE←((EQV*2)+EIV*2)*0.5
[8]     NOE←((EQO*2)+EIO*2)*0.5
[9]     NV←÷NVE[1↑⍒NVE]
[10]    NO←÷NOE[1↑⍒NOE]
[11]    '3' EVAL 30
[12]    EV←NV×(((QV←EQV)*2)+(IV←EIV)*2)*
        0.5
[13]    EO←NO×(((QO←EQO)*2)+(IO←EIO)*2)*
        0.5
[14]    QTOD[;J]←1 PD QTO3[;J]×NO
[15]    ITOD[;J]←1 PD ITO3[;J]×NO
[16]    QTVD[;J]←1 PD QTV3[;J]×NV
[17]    ITVD[;J]←1 PD ITV3[;J]×NV
[18]    'D' EVAL 30
[19]    DEV←((IV×EIV)+QV×EQV)÷EV
[20]    DEO←((IO×EIO)+QO×EQO)÷EO
[21]    ΔECM←ΔECM,(EV-EO)÷-0.05×DEV+DEO
[22]    →DO
    ∇
```

PD computes the Dth derivative of the polynomial, P. P must be arranged in ascending order of degree starting with zero and all terms must be accounted for.

```
      ∇PD[⎕]∇
    ∇ R←D PD P;K;L
[1]     K←0
[2]     L←⍴P
[3]   DO:→0×⍳K=D⌊L
[4]     R←P←1↓P×¯1+⍳⍴P
[5]     K←K+1
[6]     →DO
    ∇
```

The program DBEL computes the adjusted attenuation that is plotted in Fig. F-16 of Appendix F.

```
      ∇DBEL[⎕]∇
    ∇ DBEL
[1]   M←⍳0
[2]   LOSS←ATTEN[;2]+1
[3]   NDB←LOSS[⍳12]
[4]   K←0
[5]   J←13
[6]  DO:→END×⍳K=2
[7]   K←K+1
[8]   N←20×10⍟DIST[J]÷DIST[1]
[9]   NN←LOSS[1]-N
[10]  M←M,NNN←NN-LOSS[J]
[11]  NDB←NDB,LOSS[J+0,⍳8]+NNN
[12]  J←22
[13]  →DO
[14] END:N←+/N÷⍴N←LOSS[30+⍳6],ATTEN[(⍳12);1],ATTEN[(30+⍳6);1]
[15]  NN←+/NN÷⍴NN←ATTEN[(12+⍳9);1]
[16]  NNN←+/NNN÷⍴NNN←ATTEN[(21+⍳9);1]
[17]  NDB←NDB,(3⍴N),(3⍴NN+M[1]),3⍴NNN+M[2]
[18]  DIST←DIST[⍳30],(3⍴CARB),(3⍴DANA),3⍴NANT
    ∇
```

REFERENCES

C-1 Anon., "APL Language," IBM Corporation Publication GC26-3847-0, March 1975.

C-2 Anon., "Graphs and Histograms in APL/360-370," IBM Corporation Publication SB21-0415-0, 1972.

Appendix D

POLYNOMIAL COEFFICIENTS

This appendix records the values of the coefficients of the polynomials that were used in the analysis of data. Tables D-1 through D-12 tabulate these coefficients. The coefficients are presented in ascending order of degree from the top to the bottom of each column of eleven coefficients. The groups of three columns under the name of each field site are coefficients for data segments 1, 2, and 3 from left to right.

The tables contain the following labels:

QTOP and QTVP	are the labels for 10th degree polynomials fitted to Q data taken at NAVOBSY and data taken simultaneously at the field site, i.e., the van. P denotes polynomials of more permanent interest; i.e., they represent the data as taken.
ITOP and ITVP	are defined the same, except the data fitted are I data.
QTOS, QTVS ITOS, and *ITVS*	are the *labels for polynomials slewed to* achieve minimum energy in Q.
QT03, QTV3, IT03, and ITV3	are the labels for polynomials slewed so that the third-cycle zero crossings align at 30 μs.

Table D-1
Polynomial Coefficients for Q Data Taken at NAVOBSY

```
          Wilmington, NC                    Emporia, VA                      Towanda, PA

      1 PRNT QTOP
¯1.3611E¯03 ¯1.0702E¯03 ¯1.6513E¯03 ¯4.2154E¯03 ¯6.3153E¯03 ¯5.8961E¯03 ¯1.8603E¯03 ¯1.3594E¯03 ¯1.5519E¯03
¯8.6702E¯03 ¯8.0823E¯03 ¯8.5907E¯03 ¯1.1479E¯02 ¯6.9351E¯03 ¯7.9246E¯03 ¯1.2534E¯02 ¯1.2236E¯02 ¯1.2247E¯02
¯1.0772E¯02 ¯1.2432E¯02 ¯8.4534E¯03 ¯5.1642E¯03 ¯3.8554E¯03 ¯3.9061E¯03 ¯1.6747E¯02 ¯2.2579E¯02 ¯1.9456E¯02
 8.6946E¯03  9.8213E¯03  6.1062E¯03  2.4760E¯03 ¯1.1920E¯03 ¯9.5935E¯04  1.4839E¯02  2.1135E¯02  1.7466E¯02
¯4.6007E¯03 ¯4.9301E¯03 ¯3.3476E¯03 ¯1.5682E¯03  6.9461E¯04  5.5592E¯04 ¯6.6441E¯03 ¯9.6625E¯03 ¯7.7628E¯03
 1.6795E¯03  1.7307E¯03  1.3456E¯03  8.8976E¯04  2.1223E¯04  2.5032E¯04  2.0030E¯03  2.7935E¯03  2.2631E¯03
¯3.3887E¯04 ¯3.4265E¯04 ¯2.8609E¯04 ¯2.1454E¯04 ¯1.0022E¯04 ¯1.0549E¯04 ¯3.6492E¯04 ¯4.8787E¯04 ¯4.0068E¯04
 3.8084E¯05  3.8167E¯05  3.3025E¯05  2.6044E¯05  1.4594E¯05  1.4955E¯05  3.9026E¯05  5.0696E¯05  4.2012E¯05
¯2.4105E¯06 ¯2.4052E¯06 ¯2.1224E¯06 ¯1.7182E¯06 ¯1.0420E¯06 ¯1.0514E¯06 ¯2.4095E¯06 ¯3.0730E¯06 ¯2.5581E¯06
 8.0862E¯08  8.0526E¯08  7.1898E¯08  5.9337E¯08  3.7564E¯08  3.7451E¯08  7.9762E¯08  1.0053E¯07  8.3820E¯08
¯1.1223E¯09 ¯1.1169E¯09 ¯1.0049E¯09 ¯8.4461E¯10 ¯5.4970E¯10 ¯5.4240E¯10 ¯1.0982E¯09 ¯1.3736E¯09 ¯1.1449E¯09
           Dexter, NY                       Danville, IN                     Marietta, OH

      10 PRNT QTOP
¯2.5838E¯03 ¯3.4954E¯04 ¯3.5477E¯04 ¯2.6701E¯05 ¯1.5014E¯04 ¯7.4360E¯04 ¯1.4737E¯03 ¯1.3984E¯03 ¯2.1373E¯03
¯8.0091E¯03 ¯5.5930E¯03 ¯5.5819E¯03  8.8673E¯04  2.6716E¯03  6.6337E¯03 ¯5.2000E¯03 ¯5.1242E¯03 ¯4.7150E¯03
¯4.6024E¯03 ¯2.0110E¯02 ¯1.9688E¯02 ¯7.7921E¯03 ¯1.3260E¯02 ¯1.8007E¯02 ¯1.0386E¯03 ¯1.1611E¯03  8.4010E¯04
 1.7733E¯03  1.7502E¯02  1.7244E¯02  7.2089E¯03  1.2499E¯02  1.4935E¯02  5.4435E¯03  5.6608E¯03  2.9734E¯03
¯1.4469E¯03 ¯8.4464E¯03 ¯8.3008E¯03 ¯3.1127E¯03 ¯5.5666E¯03 ¯6.2237E¯03 ¯3.5158E¯03 ¯3.6618E¯03 ¯2.2274E¯03
 8.0485E¯04  2.5508E¯03  2.5004E¯03  7.6378E¯04  1.4038E¯03  1.4963E¯03  1.0909E¯03  1.1330E¯03  7.3339E¯04
¯2.1908E¯04 ¯4.5040E¯04 ¯4.4016E¯04 ¯1.1488E¯04 ¯2.1533E¯04 ¯2.2060E¯04 ¯1.9207E¯04 ¯1.9835E¯04 ¯1.3392E¯04
 2.7027E¯05  4.6336E¯05  4.5097E¯05  1.0837E¯05  2.0503E¯05  2.0309E¯05  2.0175E¯05  2.0693E¯05  1.4443E¯05
¯1.7972E¯06 ¯2.7494E¯06 ¯2.6621E¯06 ¯6.2429E¯07 ¯1.1818E¯06 ¯1.1380E¯06 ¯1.2502E¯06 ¯1.2739E¯06 ¯9.1352E¯07
 6.2077E¯08  8.7538E¯08  8.4251E¯08  2.0002E¯08  3.7690E¯08  3.5451E¯08  4.2187E¯08  4.2669E¯08  3.1287E¯08
¯3.7787E¯10 ¯1.1612E¯09 ¯1.1102E¯09 ¯2.7232E¯10 ¯5.0958E¯10 ¯4.7006E¯10 ¯5.9633E¯10 ¯5.9911E¯10 ¯4.4741E¯10
           Georgetown, DE                   Toms River, NJ                   Grottoes, VA

      19 PRNT QTOP
¯9.7391E¯06 ¯5.1329E¯05 ¯9.4713E¯05 ¯7.7912E¯03 ¯1.6842E¯03 ¯3.2227E¯03 ¯4.8736E¯03 ¯5.6599E¯03 ¯5.7249E¯03
¯4.8196E¯04 ¯1.1879E¯03 ¯1.4712E¯03 ¯6.6283E¯03 ¯1.4650E¯02 ¯1.5696E¯02 ¯1.0338E¯02 ¯1.0325E¯02 ¯1.3337E¯02
¯5.6275E¯03 ¯6.0777E¯03 ¯4.6653E¯03 ¯2.4566E¯04 ¯2.3927E¯02 ¯9.9588E¯03 ¯1.5299E¯04  3.0757E¯04  3.3852E¯04
 8.2313E¯03  9.0561E¯03  7.9408E¯03  2.0472E¯04  3.2777E¯02  1.9985E¯02  4.3897E¯03  3.3991E¯03  7.4690E¯03
¯4.4045E¯03 ¯4.7965E¯03 ¯4.3912E¯03 ¯6.7753E¯06 ¯1.6674E¯02 ¯1.1944E¯02 ¯2.6315E¯03 ¯2.0163E¯03 ¯4.9743E¯03
 1.2519E¯03  1.3414E¯03  1.2586E¯03  7.4971E¯05  4.5530E¯03  3.6634E¯03  8.6922E¯04  6.9171E¯04  1.6260E¯03
¯2.0847E¯04 ¯2.1993E¯04 ¯2.0939E¯04 ¯2.4874E¯05 ¯7.2863E¯04 ¯6.3856E¯04 ¯1.6488E¯04 ¯1.3613E¯04 ¯2.9824E¯04
 2.1012E¯05  2.1887E¯05  2.1021E¯05  3.3943E¯06  7.0348E¯05  6.5810E¯05  1.8307E¯05  1.5531E¯05  3.2070E¯05
¯1.2609E¯06 ¯1.3007E¯06 ¯1.2559E¯06 ¯2.3978E¯07 ¯4.0350E¯06 ¯3.9767E¯06 ¯1.1818E¯06 ¯1.0229E¯06 ¯2.0139E¯06
 4.1418E¯08  4.2420E¯08  4.1091E¯08  8.7453E¯09  1.2667E¯07  1.3036E¯07  4.1171E¯08  3.6194E¯08  6.8447E¯08
¯5.7276E¯10 ¯5.8360E¯10 ¯5.6641E¯10 ¯1.3085E¯10 ¯1.6766E¯09 ¯1.7906E¯09 ¯5.9880E¯10 ¯5.3298E¯10 ¯9.7360E¯10
           Bluefield, WV                  Baseline, Day 154                Baseline, Day 188

      28 PRNT QTOP
¯3.9121E¯03 ¯2.4772E¯03 ¯2.8705E¯03 ¯6.8555E¯03 ¯5.3612E¯03 ¯4.3018E¯03 ¯4.2138E¯03 ¯4.2455E¯03 ¯4.5206E¯03
¯8.7291E¯03 ¯7.7891E¯03 ¯6.3276E¯03 ¯5.0551E¯03 ¯9.3130E¯03 ¯1.0134E¯02 ¯1.4057E¯02 ¯1.3721E¯02 ¯1.3567E¯02
¯4.2067E¯03 ¯4.2838E¯03 ¯3.1234E¯03 ¯5.0483E¯03 ¯3.8932E¯03 ¯4.7654E¯03 ¯9.4226E¯03 ¯9.1846E¯03 ¯8.9478E¯03
 1.6573E¯03  2.9006E¯03  1.0167E¯03 ¯8.4312E¯04 ¯2.9933E¯04  8.3317E¯04  3.6948E¯03  3.1979E¯03  2.2022E¯03
 6.2482E¯04 ¯3.5945E¯04  4.2575E¯04  9.5620E¯04  1.6057E¯04 ¯3.0885E¯04 ¯3.7990E¯04  9.1297E¯05  5.2728E¯04
¯3.4706E¯04 ¯5.0685E¯05 ¯2.1448E¯04  3.8803E¯05  3.7432E¯04  5.0955E¯04  2.9042E¯04  1.1371E¯04  4.1750E¯05
 6.7326E¯05  1.8735E¯05  3.7879E¯05 ¯5.9269E¯05 ¯1.2868E¯04 ¯1.4880E¯04 ¯9.4595E¯05 ¯5.7216E¯05 ¯5.3560E¯05
¯6.9356E¯06 ¯2.1624E¯06 ¯3.4055E¯06  9.5540E¯06  1.7515E¯05  1.9280E¯05  1.2446E¯05  8.1464E¯06  8.5172E¯06
 3.9987E¯07  1.1916E¯07  1.5870E¯07 ¯6.9614E¯07 ¯1.2131E¯06 ¯1.3024E¯06 ¯8.1713E¯07 ¯5.3227E¯07 ¯5.9361E¯07
¯1.2096E¯08 ¯2.9846E¯09 ¯3.2975E¯09  2.5002E¯08  4.2845E¯08  4.5232E¯08  2.6816E¯08  1.6669E¯08  1.9835E¯08
 1.4862E¯10  2.3124E¯11  1.5754E¯11 ¯3.6137E¯10 ¯6.1605E¯10 ¯6.4182E¯10 ¯3.5249E¯10 ¯2.0197E¯10 ¯2.6019E¯10
```

Table D-2

Polynomial Coefficients for Q Data Taken at Field Sites

```
          Wilmington, NC                              Emporia, VA                              Towanda, PA
    1 PRNT QTVP
¯3.9435E¯03 ¯3.9580E¯03 ¯3.9124E¯03 ¯6.3398E¯03 ¯6.0672E¯03 ¯6.3115E¯03 ¯1.4463E¯04 ¯1.4660E¯04 ¯1.1182E¯03
¯8.5863E¯03 ¯8.5788E¯03 ¯8.3722E¯03 ¯9.7117E¯03 ¯8.7483E¯03 ¯8.7634E¯03 ¯3.3310E¯03 ¯3.4248E¯03 ¯7.6824E¯03
¯4.8567E¯03 ¯4.7750E¯03 ¯4.7862E¯03 ¯2.9579E¯03 ¯2.7013E¯03 ¯2.9371E¯03 ¯1.7400E¯02 ¯1.8256E¯02 ¯8.9438E¯03
 5.1924E¯04  5.0060E¯04  4.4787E¯04  1.6862E¯04  3.2942E¯05 ¯9.0495E¯05  2.0084E¯02  1.9985E¯02  1.3556E¯02
 7.0012E¯04  6.5866E¯04  7.1325E¯04  1.0840E¯04  2.2460E¯04  3.4100E¯04 ¯1.0126E¯02 ¯1.0041E¯02 ¯7.4797E¯03
¯5.6070E¯05 ¯3.1532E¯05 ¯5.7075E¯05  3.0129E¯04  2.5312E¯04  2.1695E¯04  2.8941E¯03  2.9100E¯03  2.2701E¯03
¯2.3800E¯05 ¯2.9551E¯05 ¯2.3734E¯05 ¯1.0430E¯04 ¯9.4340E¯05 ¯8.8295E¯05 ¯4.8189E¯04 ¯4.9217E¯04 ¯3.9167E¯04
 4.7130E¯06  5.4185E¯06  4.7042E¯06  1.4136E¯05  1.2979E¯05  1.2385E¯05  4.7505E¯05  4.9217E¯05  3.9435E¯05
¯3.5248E¯07 ¯4.0020E¯07 ¯3.5141E¯07 ¯9.7034E¯07 ¯8.9317E¯07 ¯8.5895E¯07 ¯2.7379E¯06 ¯2.8730E¯06 ¯2.3035E¯06
 1.2260E¯08  1.3956E¯08  1.2203E¯08  3.3926E¯08  3.1169E¯08  3.0094E¯08  8.5422E¯08  9.0669E¯08  7.2539E¯08
¯1.6600E¯10 ¯1.9073E¯10 ¯1.6487E¯10 ¯4.8324E¯10 ¯4.4238E¯10 ¯4.2816E¯10 ¯1.1162E¯09 ¯1.1970E¯09 ¯9.5438E¯10

            Dexter, NY                                Danville, IN                             Marietta, OH
    10 PRNT QTVP
¯5.9869E¯03 ¯3.2072E¯03 ¯1.1007E¯03 ¯4.1431E¯03 ¯4.2464E¯03 ¯4.2311E¯03  2.3173E¯03  1.6815E¯03  2.6045E¯03
 2.2980E¯02  1.3306E¯02  5.7945E¯03 ¯1.5420E¯02 ¯1.5705E¯02 ¯1.5671E¯02  1.0779E¯02  1.0051E¯02  1.0829E¯02
¯3.4540E¯02 ¯2.1496E¯02 ¯1.1568E¯02 ¯5.4779E¯03 ¯5.4786E¯03 ¯5.5239E¯03  7.0518E¯03  9.9793E¯03  5.8176E¯03
 2.6103E¯02  1.7289E¯02  1.0975E¯02  1.4855E¯02  1.5020E¯02  1.4949E¯02 ¯1.1771E¯02 ¯1.4149E¯02 ¯1.0343E¯02
¯1.0901E¯02 ¯7.5841E¯03 ¯5.3008E¯03 ¯7.6676E¯03 ¯7.7958E¯03 ¯7.7500E¯03  5.4473E¯03  6.4345E¯03  4.7528E¯03
 2.7212E¯03  1.9784E¯03  1.4725E¯03  2.0641E¯03  2.1079E¯03  2.0963E¯03 ¯1.3577E¯03 ¯1.5941E¯03 ¯1.1762E¯03
¯4.1443E¯04 ¯3.1171E¯04 ¯2.4084E¯04 ¯3.2902E¯04 ¯3.3715E¯04 ¯3.3555E¯04  2.0291E¯04  2.3731E¯04  1.7497E¯04
 3.8598E¯05  2.9729E¯05  2.3443E¯05  3.2042E¯05  3.2925E¯05  3.2797E¯05 ¯1.8720E¯05 ¯2.1809E¯05 ¯1.6111E¯05
¯2.1435E¯06 ¯1.6775E¯06 ¯1.3357E¯06 ¯1.8718E¯06 ¯1.9277E¯06 ¯1.9217E¯06  1.0452E¯06  1.2125E¯06  9.0007E¯07
 6.5207E¯08  5.1559E¯08  4.1179E¯08  6.0203E¯08  6.2114E¯08  6.1971E¯08 ¯3.2342E¯08 ¯3.7346E¯08 ¯2.7916E¯08
¯8.3676E¯10 ¯6.6588E¯10 ¯5.3109E¯10 ¯8.1885E¯10 ¯8.4609E¯10 ¯8.4473E¯10  4.2488E¯10  4.8039E¯10  3.6794E¯10

          Georgetown, DE                              Toms River, NJ                           Grottoes, VA
    19 PRNT QTVP
¯9.6804E¯04 ¯7.8681E¯04 ¯3.2625E¯04 ¯5.1299E¯03 ¯6.6822E¯03 ¯6.8537E¯03 ¯6.4154E¯04 ¯5.6021E¯04 ¯8.7765E¯04
¯2.1490E¯03 ¯2.6213E¯03 ¯2.0712E¯03 ¯1.3112E¯02 ¯1.3756E¯02 ¯1.3958E¯02 ¯2.3547E¯03 ¯3.0364E¯03 ¯2.9194E¯03
 1.5344E¯03  4.5466E¯04 ¯1.4085E¯03 ¯2.3694E¯03 ¯1.0521E¯03 ¯9.2465E¯04 ¯7.2397E¯05 ¯1.7521E¯03 ¯8.5073E¯05
 2.6986E¯03  4.0130E¯03  5.6973E¯03  6.2634E¯03  4.5983E¯03  4.6412E¯03  3.5515E¯03  6.0214E¯03  3.5242E¯03
¯2.1165E¯03 ¯2.7340E¯03 ¯3.4698E¯03 ¯3.3869E¯03 ¯2.7759E¯03 ¯2.8361E¯03 ¯2.1324E¯03 ¯3.4542E¯03 ¯2.1111E¯03
 7.0643E¯04  8.6107E¯04  1.0472E¯03  1.0669E¯03  9.7546E¯04  1.0023E¯03  6.3045E¯04  9.9822E¯04  6.2779E¯04
¯1.2820E¯04 ¯1.5063E¯04 ¯1.7937E¯04 ¯1.9656E¯04 ¯1.9328E¯04 ¯1.9905E¯04 ¯1.0668E¯04 ¯1.6580E¯04 ¯1.0698E¯04
 1.3561E¯05  1.5516E¯05  1.8252E¯05  2.1310E¯05  2.2003E¯05  2.2680E¯05  1.0732E¯05  1.6437E¯05  1.0816E¯05
¯8.3680E¯07 ¯9.3829E¯07 ¯1.0947E¯06 ¯1.3453E¯06 ¯1.4393E¯06 ¯1.4841E¯06 ¯6.3562E¯07 ¯9.6233E¯07 ¯6.4208E¯07
 2.7946E¯08  3.0842E¯08  3.5770E¯08  4.5882E¯08  5.0454E¯08  5.2034E¯08  2.0503E¯08  3.0741E¯08  2.0710E¯08
¯3.9037E¯10 ¯4.2536E¯10 ¯4.9106E¯10 ¯6.5407E¯10 ¯7.3525E¯10 ¯7.5835E¯10 ¯2.7815E¯10 ¯4.1345E¯10 ¯2.8040E¯10

           Bluefield, WV                            Baseline, Day 154                       Baseline, Day 188
    28 PRNT QTVP
 7.2776E¯04  1.2794E¯03  9.1799E¯04 ¯4.3567E¯03 ¯3.7523E¯03 ¯3.8399E¯03 ¯3.7251E¯03 ¯1.4941E¯05 ¯3.9614E¯03
 3.9907E¯03  5.0096E¯03  4.2901E¯03 ¯7.5338E¯03 ¯8.2792E¯03 ¯6.4224E¯03 ¯1.4103E¯02 ¯1.0804E¯03 ¯1.4102E¯02
 1.4294E¯03  6.0008E¯06  8.7398E¯04 ¯2.0811E¯03 ¯1.8633E¯03 ¯2.3433E¯03 ¯9.3300E¯03 ¯1.9191E¯02 ¯8.8920E¯03
¯1.0536E¯02 ¯8.8485E¯03 ¯9.0697E¯03  5.1438E¯04  2.1142E¯03  3.0325E¯04  6.5811E¯03  1.2300E¯02  5.5985E¯03
 6.9479E¯03  5.9986E¯03  5.9349E¯03 ¯2.1741E¯04 ¯1.1703E¯03  2.5805E¯04 ¯2.7467E¯03 ¯4.9908E¯03 ¯2.1825E¯03
¯2.0007E¯03 ¯1.7335E¯03 ¯1.7017E¯03  3.0457E¯04  6.2487E¯04  1.4956E¯04  1.0825E¯03  1.5646E¯03  9.2444E¯04
 3.1564E¯04  2.7251E¯04  2.6819E¯04 ¯8.5188E¯05 ¯1.4821E¯04 ¯6.1459E¯05 ¯2.3524E¯04 ¯2.8033E¯04 ¯2.0972E¯04
¯2.9182E¯05 ¯2.4971E¯05 ¯2.4752E¯05  1.0342E¯05  1.7545E¯05  8.2254E¯06  2.7274E¯05  3.0062E¯05  2.4795E¯05
 1.5748E¯06  1.3287E¯06  1.3297E¯06 ¯6.4498E¯07 ¯1.1174E¯06 ¯5.7999E¯07 ¯1.7354E¯06 ¯1.7740E¯06 ¯1.5930E¯06
¯4.5865E¯08 ¯3.7951E¯08 ¯3.8417E¯08  2.0474E¯08  3.7010E¯08  1.6922E¯08  5.7721E¯08  5.5686E¯08  5.3264E¯08
 5.5609E¯10  4.4830E¯10  4.6021E¯10 ¯2.6396E¯10 ¯5.0388E¯10 ¯2.1624E¯10 ¯7.8865E¯10 ¯7.2631E¯10 ¯7.3010E¯10
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Table D-3

Polynomial Coefficients for I Data Taken at NAVOBSY

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          Wilmington, NC                            Emporia, VA                              Towanda, PA
     1 PRNT ITOP
  2.0045E¯03  2.2003E¯03  1.8809E¯03  1.7284E¯03  2.1064E¯03  2.4089E¯03  1.5812E¯03  1.2381E¯03  1.4547E¯03
  1.5730E¯02  1.6009E¯02  1.5469E¯02  1.6592E¯02  1.7280E¯02  1.7920E¯02  1.3062E¯02  1.1994E¯02  1.2913E¯02
  2.6223E¯02  2.4552E¯02  2.7093E¯02  3.4998E¯02  3.0476E¯02  2.8441E¯02  2.4064E¯02  2.6417E¯02  2.5524E¯02
 ¯1.4940E¯02 ¯1.3231E¯02 ¯1.6213E¯02 ¯2.0325E¯02 ¯1.7305E¯02 ¯1.4938E¯02 ¯9.5037E¯03 ¯1.0590E¯02 ¯1.0537E¯02
  1.4994E¯02  1.4183E¯02  1.5576E¯02  1.6545E¯02  1.5046E¯02  1.4047E¯02  1.1236E¯02  1.1431E¯02  1.1647E¯02
 ¯5.6172E¯03 ¯5.4027E¯03 ¯5.7564E¯03 ¯5.8785E¯03 ¯5.4508E¯03 ¯5.2226E¯03 ¯4.4503E¯03 ¯4.4513E¯03 ¯4.5481E¯03
  1.0453E¯03  1.0127E¯03  1.0663E¯03  1.0828E¯03  1.0114E¯03  9.8029E¯04  8.5219E¯04  8.4741E¯04  8.6651E¯04
 ¯1.1028E¯04 ¯1.0714E¯04 ¯1.1208E¯04 ¯1.1462E¯04 ¯1.0745E¯04 ¯1.0487E¯04 ¯9.1455E¯05 ¯9.0688E¯05 ¯9.2731E¯05
  6.6986E¯06  6.5253E¯06  6.7981E¯06  7.0336E¯06  6.6083E¯06  6.4807E¯06  5.6218E¯06  5.5655E¯06  5.6886E¯06
 ¯2.1862E¯07 ¯2.1343E¯07 ¯2.2170E¯07 ¯2.3228E¯07 ¯2.1858E¯07 ¯2.1513E¯07 ¯1.8480E¯07 ¯1.8274E¯07 ¯1.8668E¯07
  2.9684E¯09  2.9032E¯09  3.0092E¯09  3.1904E¯09  3.0058E¯09  2.9664E¯09  2.5182E¯09  2.4880E¯09  2.5399E¯09

           Dexter, NY                               Danville, IN                             Marietta, OH
    10 PRNT ITOP
  2.5176E¯03  3.4987E¯03  3.7681E¯03  5.3371E¯03  6.6730E¯03  8.5172E¯03  4.2642E¯03  3.3047E¯03  2.8325E¯03
  1.7116E¯02  1.6675E¯02  1.7311E¯02 ¯2.7847E¯02 ¯3.0860E¯02 ¯3.8666E¯02 ¯2.2702E¯02 ¯1.8315E¯02 ¯1.6415E¯02
  2.3763E¯02  1.6499E¯02  1.6154E¯02  4.2875E¯02  4.1962E¯02  5.2953E¯02  3.4252E¯02  2.7944E¯02  2.5893E¯02
 ¯1.4278E¯02 ¯4.0141E¯03 ¯4.3171E¯03 ¯1.9154E¯02 ¯1.6469E¯02 ¯2.3104E¯02 ¯1.2079E¯02 ¯8.0731E¯03 ¯6.9409E¯03
  1.5395E¯02  9.5917E¯03  9.8947E¯03  7.6602E¯03  6.2601E¯03  8.4371E¯03  4.7570E¯03  3.3733E¯03  2.9842E¯03
 ¯5.8218E¯03 ¯4.1370E¯03 ¯4.2372E¯03 ¯1.9457E¯03 ¯1.5882E¯03 ¯2.0177E¯03 ¯1.2890E¯03 ¯1.0014E¯03 ¯9.1474E¯04
  1.0852E¯03  8.0614E¯04  8.2308E¯04  3.0158E¯04  2.4901E¯04  3.0228E¯04  2.1266E¯04  1.7505E¯04  1.6266E¯04
 ¯1.1423E¯04 ¯8.6777E¯05 ¯8.8403E¯05 ¯2.8983E¯05 ¯2.4318E¯05 ¯2.8495E¯05 ¯2.1606E¯05 ¯1.8497E¯05 ¯1.7375E¯05
  6.9252E¯06  5.3380E¯06  5.4276E¯06  1.6800E¯06  1.4329E¯06  1.6334E¯06  1.3139E¯06  1.1564E¯06  1.0944E¯06
 ¯2.2557E¯07 ¯1.7574E¯07 ¯1.7830E¯07 ¯5.3498E¯08 ¯4.6290E¯08 ¯5.1667E¯08 ¯4.3543E¯08 ¯3.9089E¯08 ¯3.7184E¯08
  3.0570E¯09  2.4015E¯09  2.4338E¯09  7.1605E¯10  6.2687E¯10  6.8849E¯10  6.0221E¯10  5.4839E¯10  5.2353E¯10

         Georgetown, DE                             Toms River, NJ                           Grottoes, VA
    19 PRNT ITOP
  7.7659E¯03 ¯5.0621E¯03 ¯5.2388E¯03  6.7832E¯03  1.5592E¯03  4.0898E¯03  7.7864E¯03  7.5985E¯03  4.1913E¯03
 ¯3.4606E¯02  4.8751E¯04  5.9599E¯04  1.5192E¯02  1.2897E¯02  1.9543E¯02  1.6102E¯02  1.6555E¯02  1.8222E¯02
  4.5642E¯02  7.8490E¯03  8.0202E¯03  9.1907E¯03  2.5195E¯02  1.9368E¯02  9.9700E¯03  1.0459E¯02  1.7232E¯02
 ¯1.7821E¯02  3.3438E¯03  3.3362E¯03  3.2017E¯03 ¯5.3235E¯03 ¯7.1285E¯03  3.8226E¯03  3.6955E¯03 ¯3.5885E¯03
  6.4236E¯03 ¯5.1830E¯04 ¯5.2905E¯04  1.7619E¯03  3.3907E¯03  6.2934E¯03  1.2185E¯03  1.3480E¯03  4.3300E¯03
 ¯1.5668E¯03 ¯1.5657E¯04 ¯1.5118E¯04 ¯1.0590E¯03 ¯9.9883E¯04 ¯2.0736E¯03 ¯8.6682E¯04 ¯9.1772E¯04 ¯1.5318E¯03
  2.3897E¯04  5.7601E¯05  5.6425E¯05  2.1489E¯04  1.4460E¯04  3.4217E¯04  1.8132E¯04  1.9101E¯04  2.7990E¯04
 ¯2.2950E¯05 ¯8.1726E¯06 ¯8.0322E¯06 ¯2.3435E¯05 ¯1.2005E¯05 ¯3.2581E¯05 ¯2.0230E¯05 ¯2.1265E¯05 ¯2.8594E¯05
  1.3430E¯06  6.0363E¯07  5.9401E¯07  1.4613E¯06  5.8574E¯07  1.8198E¯06  1.2883E¯06  1.3518E¯06  1.7159E¯06
 ¯4.3397E¯08 ¯2.2675E¯08 ¯2.2321E¯08 ¯4.8842E¯08 ¯1.5508E¯08 ¯5.5283E¯08 ¯4.3834E¯08 ¯4.5926E¯08 ¯5.5920E¯08
  5.9051E¯10  3.4145E¯10  3.3604E¯10  6.7740E¯10  1.6988E¯10  7.0392E¯10  6.1652E¯10  6.4516E¯10  7.6166E¯10

          Bluefield, WV                             Baseline, Day 154                        Baseline, Day 188
    28 PRNT ITOP
  4.3741E¯03  3.0811E¯03  5.5845E¯03  2.0669E¯03  2.2733E¯03  2.0799E¯03  1.3745E¯03  1.5337E¯03  1.7358E¯03
  2.0002E¯02  1.7469E¯02  1.8907E¯02  1.6583E¯02  1.7505E¯02  1.6881E¯02  1.1352E¯02  1.1380E¯02  1.2376E¯02
  1.8384E¯02  1.9954E¯02  1.1499E¯02  2.8430E¯02  2.8452E¯02  2.9266E¯02  2.1717E¯02  1.9766E¯02  2.0247E¯02
 ¯8.1555E¯03 ¯1.1242E¯02 ¯4.4464E¯03 ¯1.5450E¯02 ¯1.6864E¯02 ¯1.7075E¯02 ¯5.0182E¯03 ¯2.8901E¯03 ¯4.0263E¯03
  6.9220E¯03  8.3893E¯03  5.9014E¯03  1.4216E¯02  1.5418E¯02  1.5391E¯02  8.6094E¯03  7.4255E¯03  8.4956E¯03
 ¯2.2598E¯03 ¯2.5999E¯03 ¯2.0755E¯03 ¯5.0632E¯03 ¯5.5830E¯03 ¯5.5592E¯03 ¯3.7008E¯03 ¯3.3699E¯03 ¯3.7476E¯03
  3.7724E¯04  4.2397E¯04  3.5567E¯04  9.2569E¯04  1.0265E¯03  1.0207E¯03  7.2585E¯04  6.7363E¯04  7.4251E¯04
 ¯3.6716E¯05 ¯4.0718E¯05 ¯3.5140E¯05 ¯9.7254E¯05 ¯1.0789E¯04 ¯1.0714E¯04 ¯7.8523E¯05 ¯7.3590E¯05 ¯8.0803E¯05
  2.1074E¯06  2.3175E¯06  2.0393E¯06  5.0339E¯06  6.5690E¯06  6.5138E¯06  4.0439E¯06  4.5665E¯06  5.0042E¯06
 ¯6.5987E¯08 ¯7.2172E¯08 ¯6.4418E¯08 ¯1.9517E¯07 ¯2.1537E¯07 ¯2.1326E¯07 ¯1.5967E¯07 ¯1.5110E¯07 ¯1.6540E¯07
  8.6767E¯10  9.4583E¯10  8.5317E¯10  2.6728E¯09  2.9394E¯09  2.9067E¯09  2.1024E¯09  2.0704E¯09  2.2651E¯09
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Table D-4

Polynomial Coefficients for I Data Taken at Field Sites

Wilmington, NC			Emporia, VA			Towanda, PA		
1 *PRNT ITVP*								
2.9970E¯03	3.0814E¯03	2.8675E¯03	2.7156E¯03	2.5243E¯03	2.8153E¯03	1.8483E¯03	8.4507E¯04	2.0912E¯03
1.5205E¯02	1.5301E¯02	1.5162E¯02	1.7438E¯02	1.6702E¯02	1.7344E¯02	1.3402E¯02	9.5356E¯03	1.4359E¯02
1.7409E¯02	1.7171E¯02	1.7985E¯02	2.4762E¯02	2.4394E¯02	2.3499E¯02	2.1398E¯02	2.4835E¯02	2.1298E¯02
¯1.7331E¯03	¯1.4751E¯03	¯2.4857E¯03	¯7.5227E¯03	¯7.9835E¯03	¯7.0027E¯03	¯8.3964E¯03	¯1.0176E¯02	¯9.1256E¯03
7.0971E¯03	6.9515E¯03	7.3521E¯03	9.4657E¯03	9.4221E¯03	9.0935E¯03	8.3837E¯03	9.2718E¯03	9.0912E¯03
¯3.3558E¯03	¯3.3190E¯03	¯3.3956E¯03	¯3.9052E¯03	¯3.8239E¯03	¯3.7679E¯03	¯3.2022E¯03	¯3.4826E¯03	¯3.4783E¯03
6.8279E¯04	6.7710E¯04	6.8564E¯04	7.6802E¯04	7.4647E¯04	7.4123E¯04	6.0430E¯04	6.5515E¯04	6.6083E¯04
¯7.5499E¯05	¯7.4973E¯05	¯7.5516E¯05	¯8.4474E¯05	¯8.1724E¯05	¯9.1488E¯05	¯6.4513E¯05	¯6.9870E¯05	¯7.1040E¯05
4.7308E¯06	4.7020E¯06	4.7201E¯06	5.3208E¯06	5.1313E¯06	5.1300E¯06	3.9660E¯06	4.2910E¯06	4.3929E¯06
¯1.5784E¯07	¯1.5698E¯07	¯1.5721E¯07	¯1.7909E¯07	¯1.7234E¯07	¯1.7260E¯07	¯1.3075E¯07	¯1.4130E¯07	¯1.4551E¯07
2.1785E¯09	2.1676E¯09	2.1671E¯09	2.4954E¯09	2.3978E¯09	2.4044E¯09	1.7890E¯09	1.9311E¯09	1.9988E¯09

Dexter, NY			Danville, IN			Marietta, OH		
10 *PRNT ITVP*								
3.6805E¯03	3.6489E¯03	4.0035E¯03	1.2416E¯03	1.1483E¯03	1.1137E¯03	¯1.1780E¯02	¯1.0673E¯02	¯1.0713E¯02
4.8394E¯03	4.6221E¯03	4.5974E¯03	1.2111E¯02	1.1778E¯02	1.1730E¯02	¯9.1299E¯04	¯2.0549E¯03	¯2.2409E¯03
4.9803E¯03	5.0219E¯03	4.7121E¯03	2.7270E¯02	2.8002E¯02	2.8647E¯02	¯1.2606E¯02	¯1.1973E¯02	¯1.1869E¯02
3.8224E¯03	3.8736E¯03	3.9672E¯03	¯9.5333E¯03	¯9.8372E¯03	¯1.0359E¯02	¯7.4869E¯03	¯7.4811E¯03	¯7.4787E¯03
¯1.1915E¯05	¯5.6861E¯05	¯5.2684E¯08	8.0772E¯03	8.1547E¯03	8.3648E¯03	1.1921E¯03	1.0628E¯03	1.0462E¯03
¯4.9896E¯04	¯4.8700E¯04	¯5.2267E¯04	¯3.0077E¯03	¯3.0247E¯03	¯3.0735E¯03	3.4107E¯04	3.8515E¯04	3.9160E¯04
1.3716E¯04	1.3553E¯04	1.4358E¯04	5.7123E¯04	5.7426E¯04	5.8125E¯04	¯1.2681E¯04	¯1.3445E¯04	¯1.3556E¯04
¯1.7465E¯05	¯1.7332E¯05	¯1.8281E¯05	¯6.2153E¯05	¯6.2507E¯05	¯6.3134E¯05	1.7642E¯05	1.8392E¯05	1.8479E¯05
1.1980E¯06	1.1913E¯06	1.2533E¯06	3.9073E¯06	3.9314E¯06	3.9658E¯06	¯1.2666E¯06	¯1.3075E¯06	¯1.3118E¯06
¯4.2659E¯08	¯4.2467E¯08	¯4.4600E¯08	¯1.3157E¯07	¯1.3244E¯07	¯1.3348E¯07	4.6166E¯08	4.7383E¯08	4.7472E¯08
6.1859E¯10	6.1619E¯10	6.4635E¯10	1.8337E¯09	1.8465E¯09	1.8600E¯09	¯6.7480E¯10	¯6.8987E¯10	¯6.9043E¯10

Georgetown, DE			Toms River, NJ			Grottoes, VA		
19 *PRNT ITVP*								
2.4360E¯03	3.3216E¯03	3.8452E¯03	4.6542E¯03	5.2603E¯03	5.2197E¯03	7.5176E¯03	7.7780E¯03	7.3531E¯03
2.7428E¯03	1.3922E¯03	¯8.9564E¯05	1.6755E¯02	1.8907E¯02	1.9261E¯02	3.8315E¯03	3.7320E¯03	3.9559E¯03
4.6386E¯03	4.9479E¯03	5.9385E¯03	1.4834E¯02	1.6185E¯02	1.6812E¯02	7.7417E¯03	8.7433E¯03	8.8178E¯03
2.3126E¯03	2.5698E¯03	2.5286E¯03	1.4237E¯03	7.7523E¯04	4.6367E¯04	3.2265E¯03	2.9589E¯03	2.8157E¯03
¯3.0871E¯04	¯4.2703E¯04	¯5.4308E¯04	2.6445E¯03	3.2530E¯03	3.4022E¯03	¯5.1137E¯04	¯5.4401E¯04	¯5.3175E¯04
¯1.3098E¯04	¯1.1749E¯04	¯7.1326E¯05	¯1.3476E¯03	¯1.5771E¯03	¯1.6207E¯03	¯1.0594E¯04	¯6.6190E¯05	¯5.7972E¯05
4.4379E¯05	4.5712E¯05	3.6333E¯05	2.6595E¯04	3.1059E¯04	3.1808E¯04	3.9740E¯05	2.9419E¯05	2.6873E¯05
¯6.1377E¯06	¯6.5944E¯06	¯5.4888E¯06	¯2.8664E¯05	¯3.3626E¯05	¯3.4406E¯05	¯5.5514E¯06	¯4.2426E¯06	¯3.9055E¯06
4.4705E¯07	4.9042E¯07	4.1555E¯07	1.7733E¯06	2.0898E¯06	2.1381E¯06	4.0835E¯07	3.1883E¯07	2.9505E¯07
¯1.6660E¯08	¯1.8498E¯08	¯1.5803E¯08	¯5.8898E¯08	¯6.9659E¯08	¯7.1287E¯08	¯1.5407E¯08	¯1.2225E¯08	¯1.1356E¯08
2.4977E¯10	2.7955E¯10	2.3964E¯10	8.1257E¯10	9.6357E¯10	9.8658E¯10	2.3405E¯10	1.8781E¯10	1.7492E¯10

Bluefield, WV			Baseline, Day 154			Baseline, Day 188		
28 *PRNT ITVP*								
4.9883E¯04	4.8467E¯04	5.2011E¯04	2.4247E¯03	3.0135E¯03	3.5212E¯03	1.1948E¯03	3.0548E¯03	1.4000E¯03
5.8701E¯03	5.5455E¯03	5.5861E¯03	1.6293E¯02	1.8269E¯02	1.0275E¯02	1.1849E¯02	¯2.6916E¯02	1.2946E¯02
1.5008E¯02	1.4677E¯02	1.3856E¯02	2.3187E¯02	2.2923E¯02	1.9363E¯02	2.6670E¯02	7.0680E¯02	2.6767E¯02
¯7.2424E¯03	¯6.6196E¯03	¯5.9711E¯03	¯1.1297E¯02	¯1.1166E¯02	¯7.7496E¯03	¯1.1304E¯02	¯5.4693E¯02	¯1.2199E¯02
1.8954E¯03	1.7025E¯03	1.5332E¯03	1.0655E¯02	1.1333E¯02	9.9206E¯03	1.1718E¯02	3.0477E¯02	1.2562E¯02
¯8.7925E¯05	¯4.7550E¯05	¯3.4220E¯05	¯3.9095E¯03	¯4.2478E¯03	¯3.9289E¯03	¯4.5251E¯03	¯8.7954E¯03	¯4.8292E¯03
¯4.6754E¯05	¯5.1676E¯05	¯4.9705E¯05	7.2330E¯04	7.9169E¯04	7.4823E¯04	8.5582E¯04	1.4247E¯03	9.1291E¯04
9.2987E¯06	9.6275E¯06	9.1153E¯06	¯7.6552E¯05	¯8.3858E¯05	¯8.0167E¯05	¯9.1048E¯05	¯1.3684E¯04	¯9.7167E¯05
¯7.5267E¯07	¯7.6347E¯07	¯7.1890E¯07	4.6979E¯06	5.1338E¯06	4.9425E¯06	5.5656E¯06	7.7500E¯06	5.9427E¯06
2.9170E¯08	2.9277E¯08	2.7408E¯08	¯1.5525E¯07	¯1.6902E¯07	¯1.6349E¯07	¯1.8244E¯07	¯2.3910E¯07	¯1.9480E¯07
¯4.4501E¯10	¯4.4451E¯10	¯4.1667E¯10	2.1343E¯09	2.3142E¯09	2.2458E¯09	2.4847E¯09	3.0980E¯09	2.6548E¯09

Table D-5

Polynomial Coefficients for Q Data Taken at NAVOBSY

```
        Wilmington, NC                        Emporia, VA                        Towanda, PA
     1 PRNT QTOS
¯1.3904E¯03 ¯1.1198E¯03 ¯1.6723E¯03 ¯4.1776E¯03 ¯6.3589E¯03 ¯5.9541E¯03 ¯1.0230E¯03 ¯1.3118E¯03 ¯1.5117E¯03
¯9.4408E¯03 ¯8.8419E¯03 ¯9.3959E¯03 ¯1.2582E¯02 ¯8.3531E¯03 ¯9.3347E¯03 ¯1.3064E¯02 ¯1.2461E¯02 ¯1.2613E¯02
¯1.2837E¯02 ¯1.4420E¯02 ¯1.0519E¯02 ¯8.1589E¯03 ¯6.7828E¯03 ¯6.4973E¯03 ¯1.8713E¯02 ¯2.4577E¯02 ¯2.1606E¯02
 9.9286E¯03  1.0953E¯02  7.3847E¯03  4.2752E¯03  5.2057E¯04  4.4795E¯04  1.5712E¯02  2.2095E¯02  1.8452E¯02
¯5.7154E¯03 ¯6.0038E¯03 ¯4.4913E¯03 ¯2.9989E¯03 ¯8.0816E¯04 ¯7.7824E¯04 ¯7.4599E¯03 ¯1.0449E¯02 ¯8.6221E¯03
 2.0820E¯03  2.1200E¯03  1.7565E¯03  1.3889E¯03  7.5210E¯04  7.4169E¯04  2.3070E¯03  3.0763E¯03  2.5772E¯03
¯4.1228E¯04 ¯4.1401E¯04 ¯3.6087E¯04 ¯3.0517E¯04 ¯1.9941E¯04 ¯1.9678E¯04 ¯4.2145E¯04 ¯5.3974E¯04 ¯4.5868E¯04
 4.5700E¯05  4.5594E¯05  4.0779E¯05  3.5524E¯05  2.5035E¯05  2.4629E¯05  4.4975E¯05  5.6113E¯05  4.8093E¯05
¯2.8571E¯06 ¯2.8516E¯06 ¯2.5873E¯06 ¯2.2941E¯06 ¯1.6789E¯06 ¯1.6444E¯06 ¯2.7697E¯06 ¯3.3994E¯06 ¯2.9254E¯06
 9.5601E¯08  9.4962E¯08  8.6909E¯08  7.8189E¯08  5.8478E¯08  5.6995E¯08  9.1458E¯08  1.1109E¯07  9.5717E¯08
¯1.3204E¯09 ¯1.3113E¯09 ¯1.2068E¯09 ¯1.1015E¯09 ¯8.3540E¯10 ¯8.1017E¯10 ¯1.2559E¯09 ¯1.5153E¯09 ¯1.3050E¯09

          Dexter, NY                          Danville, IN                       Marietta, OH
     10 PRNT QTOS
¯2.6364E¯03 ¯4.5926E¯04 ¯4.8859E¯04  2.6413E¯05 ¯7.3789E¯05 ¯6.1842E¯04 ¯1.5255E¯03 ¯1.4288E¯03 ¯2.1701E¯03
¯8.8667E¯03 ¯6.0246E¯03 ¯6.0952E¯03  5.9163E¯04  2.2928E¯03  5.0506E¯03 ¯4.8539E¯03 ¯4.8968E¯03 ¯4.4619E¯03
¯5.8702E¯03 ¯2.1184E¯02 ¯2.0853E¯02 ¯7.3398E¯03 ¯1.2740E¯02 ¯1.7215E¯02 ¯1.5887E¯03 ¯1.5318E¯03  4.1412E¯04
 2.5724E¯03  1.7909E¯02  1.7705E¯02  7.0024E¯03  1.2282E¯02  1.4578E¯02  5.5569E¯03  5.7864E¯03  3.1036E¯03
¯2.2784E¯03 ¯8.9532E¯03 ¯8.8748E¯03 ¯3.0319E¯03 ¯5.4864E¯03 ¯6.0964E¯03 ¯3.5994E¯03 ¯3.7133E¯03 ¯2.2828E¯03
 1.1340E¯03  2.7496E¯03  2.7248E¯03  7.4368E¯04  1.3843E¯03  1.4568E¯03  1.1128E¯03  1.1473E¯03  7.4956E¯04
¯2.7602E¯04 ¯4.8767E¯04 ¯4.8217E¯04 ¯1.1181E¯04 ¯2.1237E¯04 ¯2.1630E¯04 ¯1.9556E¯04 ¯2.0073E¯04 ¯1.3069E¯04
 3.2957E¯05  5.0254E¯05  4.9506E¯05  1.0546E¯05  2.0222E¯05  1.9913E¯05  2.0518E¯05  2.0935E¯05  1.4730E¯05
¯2.1535E¯06 ¯2.9862E¯06 ¯2.9282E¯06 ¯6.0756E¯07 ¯1.1656E¯06 ¯1.1157E¯06 ¯1.2711E¯06 ¯1.2885E¯06 ¯9.3115E¯07
 7.3584E¯08  9.5229E¯08  9.2884E¯08  1.9474E¯08  3.7177E¯08  3.4757E¯08  4.2845E¯08  4.3150E¯08  3.1873E¯08
¯1.0326E¯09 ¯1.2651E¯09 ¯1.2267E¯09 ¯2.6530E¯10 ¯5.0276E¯10 ¯4.6094E¯10 ¯6.0523E¯10 ¯6.0569E¯10 ¯4.5550E¯10

        Georgetown, DE                        Toms River, NJ                     Grottoes, VA
     19 PRNT QTOS
¯4.7290E¯04  2.2072E¯04  2.2174E¯04 ¯7.9357E¯03 ¯1.6775E¯03 ¯3.2419E¯03 ¯5.2113E¯03 ¯5.9857E¯03 ¯5.8226E¯03
 1.6717E¯03 ¯1.1029E¯03 ¯1.4069E¯03 ¯7.0164E¯03 ¯1.4693E¯02 ¯1.5897E¯02 ¯1.1235E¯02 ¯1.1257E¯02 ¯1.4320E¯02
¯8.5117E¯03 ¯6.6980E¯03 ¯5.3371E¯03 ¯4.8567E¯04 ¯2.4273E¯02 ¯1.0319E¯02 ¯8.4384E¯04 ¯3.8524E¯04 ¯8.3065E¯04
 9.4234E¯03  9.0284E¯03  7.8960E¯03  1.2243E¯04  3.2911E¯02  2.0167E¯02  4.2617E¯03  3.2476E¯03  7.8450E¯03
¯4.8301E¯03 ¯4.8190E¯03 ¯4.4118E¯03 ¯5.4635E¯05 ¯1.6733E¯02 ¯1.2058E¯02 ¯2.7390E¯03 ¯2.1252E¯03 ¯5.2847E¯03
 1.3526E¯03  1.3588E¯03  1.2770E¯03  1.0319E¯04  4.5672E¯03  3.6966E¯03  9.2745E¯04  7.5167E¯04  1.7285E¯03
¯2.2336E¯04 ¯2.2391E¯04 ¯2.1369E¯04 ¯3.0559E¯05 ¯7.3050E¯04 ¯6.4369E¯04 ¯1.7632E¯04 ¯1.4801E¯04 ¯3.1550E¯04
 2.2400E¯05  2.2369E¯05  2.1545E¯05  4.0107E¯06  7.0491E¯05  6.6273E¯05  1.9536E¯05  1.6814E¯05  3.3772E¯05
¯1.3400E¯06 ¯1.3335E¯06 ¯1.2917E¯06 ¯2.7800E¯07 ¯4.0414E¯06 ¯4.0014E¯06 ¯1.2578E¯06 ¯1.1025E¯06 ¯2.1122E¯06
 4.3911E¯08  4.3588E¯08  4.2367E¯08  1.0016E¯08  1.2682E¯07  1.3108E¯07  4.3689E¯08  3.8837E¯08  7.1552E¯08
¯6.0591E¯10 ¯6.0052E¯10 ¯5.8480E¯10 ¯1.4839E¯10 ¯1.6780E¯09 ¯1.7992E¯09 ¯6.3336E¯10 ¯5.6934E¯10 ¯1.0146E¯09

        Bluefield, WV                     Baseline, Day 154                  Baseline, Day 188
     28 PRNT QTOS
¯3.9491E¯03 ¯2.4658E¯03 ¯2.8099E¯03 ¯6.9233E¯03 ¯5.3896E¯03 ¯4.3051E¯03 ¯4.0199E¯03 ¯4.0671E¯03 ¯4.3821E¯03
¯8.9652E¯03 ¯7.6900E¯03 ¯6.0920E¯03 ¯6.4498E¯03 ¯1.0678E¯02 ¯1.1445E¯02 ¯1.4959E¯02 ¯1.4693E¯02 ¯1.4654E¯02
¯4.4502E¯03 ¯4.1531E¯03 ¯2.9556E¯03 ¯7.9356E¯03 ¯6.5182E¯03 ¯7.5952E¯03 ¯1.2723E¯02 ¯1.2325E¯02 ¯1.1933E¯02
 1.7563E¯03  2.8304E¯03  9.6262E¯04  8.5503E¯04  1.3083E¯03  2.5381E¯03  4.5219E¯03  3.7002E¯03  2.8196E¯03
 5.4019E¯04 ¯3.0833E¯04  5.0044E¯04 ¯5.2996E¯04 ¯1.3059E¯03 ¯1.8854E¯03 ¯1.6972E¯03 ¯1.1062E¯03 ¯7.5613E¯04
¯3.1913E¯04 ¯6.6498E¯05 ¯2.4110E¯04  5.6503E¯04  8.9953E¯04  1.0497E¯03  8.4956E¯04  6.4391E¯04  5.9755E¯04
 6.2627E¯05  2.1317E¯05  4.2474E¯05 ¯1.5469E¯04 ¯2.2421E¯04 ¯2.4676E¯04 ¯2.0076E¯04 ¯1.6144E¯04 ¯1.6207E¯04
¯6.4754E¯06 ¯2.4109E¯06 ¯3.8621E¯06  1.9499E¯05  2.7458E¯05  2.9453E¯05  2.3775E¯05  1.9390E¯05  2.0188E¯05
 3.7331E¯07  1.3334E¯07  1.8530E¯07 ¯1.2986E¯06 ¯1.8132E¯06 ¯1.9152E¯06 ¯1.5087E¯06 ¯1.2236E¯06 ¯1.3099E¯06
¯1.1261E¯08 ¯3.4267E¯09 ¯4.1398E¯09  4.4695E¯08  6.2308E¯08  6.5133E¯08  4.9431E¯08  3.9337E¯08  4.3346E¯08
 1.3760E¯10  2.8322E¯11  2.6913E¯11 ¯6.2959E¯10 ¯8.8064E¯10 ¯9.1110E¯10 ¯6.5969E¯10 ¯5.1200E¯10 ¯5.8048E¯10
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Table D-6

Polynomial Coefficients for Q Data Taken at Field Sites

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        Wilmington, NC                      Emporia, VA                        Towanda, PA
    1 PRNT QTVS
¯4.0478E¯03 ¯4.0694E¯03 ¯4.0091E¯03 ¯6.3984E¯03 ¯6.1213E¯03 ¯6.3997E¯03 ¯2.6669E¯04 ¯1.6664E¯04 ¯1.1837E¯03
¯9.6254E¯03 ¯9.6327E¯03 ¯9.4091E¯03 ¯1.1424E¯02 ¯1.0603E¯02 ¯1.0620E¯02 ¯4.0507E¯03 ¯3.6938E¯03 ¯8.8159E¯03
¯6.2725E¯03 ¯6.1773E¯03 ¯6.2483E¯03 ¯5.8167E¯03 ¯5.9227E¯03 ¯5.8849E¯03 ¯2.0686E¯02 ¯2.1827E¯02 ¯1.2044E¯02
 6.5150E¯04  6.1440E¯04  6.4155E¯04  1.0973E¯03  1.1584E¯03  8.4665E¯04  2.1629E¯02  2.1683E¯02  1.5092E¯02
 1.1045E¯04  7.6001E¯05  1.0282E¯04 ¯1.0389E¯03 ¯1.0826E¯03 ¯8.6139E¯04 ¯1.1245E¯02 ¯1.1232E¯02 ¯8.6792E¯03
 2.2133E¯04  2.4448E¯04  2.2355E¯04  7.6510E¯04  7.7264E¯04  7.0542E¯04  3.2772E¯03  3.3153E¯03  2.6918E¯03
¯7.9856E¯05 ¯8.5440E¯05 ¯8.0018E¯05 ¯1.9412E¯04 ¯1.9413E¯04 ¯1.8292E¯04 ¯5.5046E¯04 ¯5.6474E¯04 ¯4.6849E¯04
 1.0873E¯05  1.1565E¯05  1.0864E¯05  2.3894E¯05  2.3764E¯05  2.2660E¯05  5.4585E¯05  5.6713E¯05  4.7475E¯05
¯7.3640E¯07 ¯7.8353E¯07 ¯7.3443E¯07 ¯1.5789E¯06 ¯1.5634E¯06 ¯1.4994E¯06 ¯3.1629E¯06 ¯3.3228E¯06 ¯2.7912E¯06
 2.5015E¯08  2.6695E¯08  2.4907E¯08  5.4241E¯08  5.3490E¯08  5.1468E¯08  9.9181E¯08  1.0521E¯07  8.8456E¯08
¯3.4145E¯10 ¯3.6599E¯10 ¯3.3939E¯10 ¯7.6430E¯10 ¯7.5069E¯10 ¯7.2384E¯10 ¯1.3017E¯09 ¯1.3928E¯09 ¯1.1704E¯09

          Dexter, NY                        Danville, IN                       Marietta, OH
    10 PRNT QTVS
¯6.7174E¯03 ¯3.7751E¯03 ¯1.5980E¯03 ¯4.0309E¯03 ¯4.1265E¯03 ¯4.1105E¯03  2.8291E¯03  2.1060E¯03  3.0638E¯03
 2.3530E¯02  1.3491E¯02  5.6924E¯03 ¯1.6100E¯02 ¯1.6346E¯02 ¯1.6302E¯02  1.0684E¯02  9.9763E¯03  1.0822E¯02
¯3.6160E¯02 ¯2.2726E¯02 ¯1.2519E¯02 ¯8.0744E¯03 ¯8.0862E¯03 ¯8.1521E¯03  7.9670E¯03  1.0843E¯02  6.6580E¯03
 2.6291E¯02  1.7300E¯02  1.0859E¯02  1.5927E¯02  1.6100E¯02  1.6056E¯02 ¯1.1549E¯02 ¯1.3974E¯02 ¯1.0099E¯02
¯1.1071E¯02 ¯7.7040E¯03 ¯5.3984E¯03 ¯8.3898E¯03 ¯8.5125E¯03 ¯8.4749E¯03  5.4359E¯03  5.4379E¯03  4.7418E¯03
 2.8010E¯03  2.0494E¯03  1.5438E¯03  2.3108E¯03  2.3517E¯03  2.3413E¯03 ¯1.3836E¯03 ¯1.6214E¯03 ¯1.2038E¯03
¯4.3113E¯04 ¯3.2746E¯04 ¯2.5727E¯04 ¯3.7405E¯04 ¯3.8162E¯04 ¯3.8011E¯04  2.1025E¯04  2.4456E¯04  1.8270E¯04
 4.0505E¯05  3.1572E¯05  2.5395E¯05  3.6825E¯05  3.7648E¯05  3.7521E¯05 ¯1.9870E¯05 ¯2.2726E¯05 ¯1.7105E¯05
¯2.2668E¯06 ¯1.7982E¯06 ¯1.4646E¯06 ¯2.1674E¯06 ¯2.2196E¯06 ¯2.2134E¯06  1.1111E¯06  1.2753E¯06  9.6870E¯07
 6.9438E¯08  5.5732E¯08  4.5657E¯08  7.0026E¯08  7.1816E¯08  7.1658E¯08 ¯3.4698E¯08 ¯3.9570E¯08 ¯3.0358E¯08
¯8.9655E¯10 ¯7.2516E¯10 ¯5.9492E¯10 ¯9.5422E¯10 ¯9.7981E¯10 ¯9.7818E¯10  4.5883E¯10  5.2028E¯10  4.0302E¯10

        Georgetown, DE                     Toms River, NJ                     Grottoes, VA
    19 PRNT QTVS
¯1.3130E¯03 ¯1.3024E¯03 ¯1.0006E¯03 ¯5.2392E¯03 ¯6.7768E¯03 ¯6.9521E¯03 ¯1.3329E¯03 ¯1.2625E¯03 ¯1.4862E¯03
¯2.6370E¯03 ¯2.7962E¯03 ¯1.8446E¯03 ¯1.3838E¯02 ¯1.4355E¯02 ¯1.4616E¯02 ¯2.6905E¯03 ¯3.3005E¯03 ¯3.2349E¯03
 4.8033E¯04 ¯7.8590E¯04 ¯3.0160E¯03 ¯3.2043E¯03 ¯1.6584E¯03 ¯1.6004E¯03 ¯9.8464E¯04 ¯2.8650E¯03 ¯1.0163E¯03
 2.4803E¯03  3.7862E¯03  5.5211E¯03  6.2952E¯03  4.6311E¯03  4.6890E¯03  3.3493E¯03  5.9173E¯03  3.3765E¯03
¯2.1317E¯03 ¯2.7385E¯03 ¯3.4636E¯03 ¯3.5499E¯03 ¯2.9088E¯03 ¯2.9853E¯03 ¯2.1222E¯03 ¯3.4630E¯03 ¯2.1003E¯03
 7.4167E¯04  8.9597E¯04  1.0756E¯03  1.1385E¯03  1.0334E¯03  1.0664E¯03  6.4816E¯04  1.0156E¯03  6.3984E¯04
¯1.3697E¯04 ¯1.5990E¯04 ¯1.8713E¯04 ¯2.1004E¯04 ¯2.0428E¯04 ¯2.1117E¯04 ¯1.1130E¯04 ¯1.6970E¯04 ¯1.1007E¯04
 1.4645E¯05  1.6706E¯05  1.9253E¯05  2.2720E¯05  2.3164E¯05  2.3959E¯05  1.1309E¯05  1.6895E¯05  1.1198E¯05
¯9.1095E¯07 ¯1.0216E¯06 ¯1.1548E¯06 ¯1.4305E¯06 ¯1.5100E¯06 ¯1.5610E¯06 ¯6.7567E¯07 ¯9.9323E¯07 ¯6.6871E¯07
 3.0592E¯08  3.3861E¯08  3.8305E¯08  4.8652E¯08  5.2767E¯08  5.4579E¯08  2.1961E¯08  3.1952E¯08  2.1686E¯08
¯4.2866E¯10 ¯4.6959E¯10 ¯5.2799E¯10 ¯6.9154E¯10 ¯7.6656E¯10 ¯7.9292E¯10 ¯2.9975E¯10 ¯4.2976E¯10 ¯2.9494E¯10

        Bluefield, WV                    Baseline, Day 154                  Baseline, Day 188
    28 PRNT QTVS
 6.5437E¯04  1.2186E¯03  8.5988E¯04 ¯4.4351E¯03 ¯3.9046E¯03 ¯4.1126E¯03 ¯3.5331E¯03 ¯6.9403E¯04 ¯3.7957E¯03
 3.5769E¯03  4.7479E¯03  4.0054E¯03 ¯9.0861E¯03 ¯1.0735E¯02 ¯8.8757E¯03 ¯1.4984E¯02  5.6039E¯03 ¯1.5127E¯02
 6.7831E¯04 ¯4.9894E¯04  3.9922E¯04 ¯4.6574E¯03 ¯5.6851E¯03 ¯5.3829E¯03 ¯1.3213E¯02 ¯3.3442E¯02 ¯1.2656E¯02
¯1.0320E¯02 ¯8.7029E¯03 ¯8.9494E¯03  1.8237E¯03  4.1140E¯03  1.6092E¯03  8.3479E¯03  2.3087E¯02  7.4110E¯03
 6.9120E¯03  5.9765E¯03  5.9190E¯03 ¯1.4264E¯03 ¯3.0715E¯03 ¯1.3511E¯03 ¯4.4154E¯03 ¯1.0817E¯02 ¯3.9149E¯03
¯2.0107E¯03 ¯1.7418E¯03 ¯1.7107E¯03  7.4067E¯04  1.3155E¯03  7.7304E¯04  1.7026E¯03  3.2045E¯03  1.5691E¯03
 3.2029E¯04  2.7602E¯04  2.7169E¯04 ¯1.6482E¯04 ¯2.7431E¯04 ¯1.7838E¯04 ¯3.4978E¯04 ¯5.4917E¯04 ¯3.2906E¯04
¯2.9079E¯05 ¯2.5486E¯05 ¯2.5256E¯05  1.8683E¯05  3.0697E¯05  2.0609E¯05  3.9244E¯05  5.4751E¯05  3.7297E¯05
 1.6263E¯06  1.3664E¯06  1.3663E¯06 ¯1.1529E¯06 ¯1.9129E¯06 ¯1.2870E¯06 ¯2.4568E¯06 ¯3.1555E¯06 ¯2.3479E¯06
¯4.7781E¯08 ¯3.9342E¯08 ¯3.9761E¯08  3.7157E¯08  6.2950E¯08  4.1801E¯08  8.1097E¯08  9.7882E¯08  7.7765E¯08
 5.0474E¯10  4.6912E¯10  4.8015E¯10 ¯4.9226E¯10 ¯8.5619E¯10 ¯5.5634E¯10 ¯1.1039E¯09 ¯1.2083E¯09 ¯1.0609E¯09
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Table D-7

Polynomial Coefficients for I Data Taken at NAVOBSY

1 *PRNT ITOS*

Wilmington, NC			Emporia, VA			Towanda, PA		
1.7482E¯03	1.3587E¯03	1.6070E¯03	1.1031E¯03	1.2454E¯03	1.5197E¯03	1.3387E¯03	1.0556E¯03	1.2417E¯03
1.4555E¯02	1.4908E¯02	1.4273E¯02	1.4699E¯02	1.5607E¯02	1.6303E¯02	1.1767E¯02	1.0801E¯02	1.1607E¯02
2.5907E¯02	2.4069E¯02	2.6978E¯02	3.5259E¯02	3.0782E¯02	2.8636E¯02	2.3218E¯02	2.5329E¯02	2.4522E¯02
¯1.4956E¯02	¯1.3137E¯02	¯1.6430E¯02	¯2.0914E¯02	¯1.8272E¯02	¯1.5780E¯02	¯8.9834E¯03	¯9.7523E¯03	¯9.8567E¯03
1.4947E¯02	1.4102E¯02	1.5620E¯02	1.6741E¯02	1.5460E¯02	1.4418E¯02	1.1011E¯02	1.1051E¯02	1.1352E¯02
¯5.5570E¯03	¯5.3370E¯03	¯5.7198E¯03	¯5.8696E¯03	¯5.4973E¯03	¯5.2627E¯03	¯4.3646E¯03	¯4.3275E¯03	¯4.4456E¯03
1.0291E¯03	9.9500E¯04	1.0527E¯03	1.0719E¯03	1.0085E¯03	9.7713E¯04	8.3360E¯04	8.2341E¯04	8.4554E¯04
¯1.0801E¯04	¯1.0485E¯04	¯1.1015E¯04	¯1.1203E¯04	¯1.0635E¯04	¯1.0381E¯04	¯8.8235E¯05	¯8.7997E¯05	¯9.0305E¯05
6.5409E¯06	6.3672E¯06	6.6594E¯06	6.8969E¯06	6.5074E¯06	6.3857E¯06	5.4738E¯06	5.3928E¯06	5.5299E¯06
¯2.1295E¯07	¯2.0778E¯07	¯2.1663E¯07	¯2.2708E¯07	¯2.1442E¯07	¯2.1124E¯07	¯1.7961E¯07	¯1.7684E¯07	¯1.8118E¯07
2.8857E¯09	2.8207E¯09	2.9341E¯09	3.1110E¯09	2.9393E¯09	2.9048E¯09	2.4434E¯09	2.4042E¯09	2.4615E¯09

10 *PRNT ITOS*

Dexter, NY			Danville, IN			Marietta, OH		
2.2486E¯03	3.3666E¯03	3.6162E¯03	5.2939E¯03	6.6210E¯03	8.4452E¯03	4.2960E¯03	3.3230E¯03	2.8399E¯03
1.6296E¯02	1.6197E¯02	1.6786E¯02	¯2.7721E¯02	¯3.0742E¯02	¯3.8527E¯02	¯2.2940E¯02	¯1.8483E¯02	¯1.6615E¯02
2.3849E¯02	1.5674E¯02	1.5266E¯02	4.2859E¯02	4.2017E¯02	5.3039E¯02	3.4318E¯02	2.7974E¯02	2.5955E¯02
¯1.4670E¯02	¯3.5033E¯03	¯3.7719E¯03	¯1.9176E¯02	¯1.6560E¯02	¯2.3228E¯02	¯1.2041E¯02	¯8.0298E¯03	¯6.9231E¯03
1.5537E¯02	9.3537E¯03	9.6403E¯03	7.6750E¯03	6.3063E¯03	8.4971E¯03	4.7192E¯03	3.3384E¯03	2.9603E¯03
¯5.8216E¯03	¯4.0544E¯03	¯4.1483E¯03	¯1.9503E¯03	¯1.6008E¯03	¯2.0334E¯03	¯1.2755E¯03	¯9.8966E¯04	¯9.0560E¯04
1.0790E¯03	7.8980E¯04	8.0546E¯04	3.0237E¯04	2.5104E¯04	3.0474E¯04	2.1013E¯04	1.7209E¯04	1.6085E¯04
¯1.1314E¯04	¯8.4958E¯05	¯8.6443E¯05	¯2.9067E¯05	¯2.4519E¯05	¯2.8733E¯05	¯2.1328E¯05	¯1.8263E¯05	¯1.7109E¯05
6.8407E¯06	5.2235E¯06	5.3044E¯06	1.6853E¯06	1.4449E¯06	1.6473E¯06	1.2960E¯06	1.1416E¯06	1.0808E¯06
¯2.2235E¯07	¯1.7191E¯07	¯1.7427E¯07	¯5.3680E¯08	¯4.6685E¯08	¯5.2116E¯08	¯4.2924E¯08	¯3.8581E¯08	¯3.6706E¯08
3.0083E¯09	2.3484E¯09	2.3771E¯09	7.1868E¯10	6.3236E¯10	6.9463E¯10	5.9326E¯10	5.4112E¯10	5.1651E¯10

19 *PRNT ITOS*

Georgetown, DE			Toms River, NJ			Grottoes, VA		
8.0742E¯03	¯5.0609E¯03	¯5.2396E¯03	6.5168E¯03	1.5277E¯03	4.0112E¯03	7.3510E¯03	7.1135E¯03	3.7115E¯03
¯3.5413E¯02	3.0184E¯04	3.6843E¯04	1.4939E¯02	1.2705E¯02	1.9270E¯02	1.5297E¯02	1.5740E¯02	1.7142E¯02
4.5722E¯02	7.4286E¯03	7.6320E¯03	9.1417E¯03	2.5012E¯02	1.9284E¯02	9.8329E¯03	1.0353E¯02	1.7311E¯02
¯1.7544E¯02	3.8400E¯03	3.8184E¯03	3.1766E¯03	¯5.0630E¯03	¯6.9280E¯03	4.0296E¯03	3.8390E¯03	¯3.3110E¯03
6.2274E¯03	¯7.6263E¯04	¯7.7839E¯04	1.7830E¯03	3.2557E¯03	6.1643E¯03	1.1024E¯03	1.2699E¯03	4.1126E¯03
¯1.5044E¯03	¯8.9113E¯05	¯8.0617E¯05	¯1.0620E¯03	¯9.6130E¯04	¯2.0318E¯03	¯8.2472E¯04	¯8.9638E¯04	¯1.5026E¯03
2.2793E¯04	4.6529E¯05	4.4664E¯05	2.1484E¯04	1.3852E¯04	3.3464E¯04	1.7274E¯04	1.8414E¯04	2.6448E¯04
¯2.1792E¯05	¯7.0624E¯06	¯6.8418E¯06	¯2.3387E¯05	¯1.1414E¯05	¯3.1788E¯05	¯1.9230E¯05	¯2.0428E¯05	¯2.6073E¯05
1.2713E¯06	5.3690E¯07	5.2206E¯07	1.4564E¯06	5.5169E¯07	1.7711E¯06	1.2214E¯06	1.2941E¯06	1.6049E¯06
¯4.0984E¯08	¯2.0471E¯08	¯1.9936E¯08	¯4.8627E¯08	¯1.4436E¯08	¯5.3669E¯08	¯4.1440E¯08	¯4.3816E¯08	¯5.2075E¯08
5.5644E¯10	3.1074E¯10	3.0273E¯10	6.7378E¯10	1.5566E¯10	6.8159E¯10	5.8096E¯10	6.1332E¯10	7.0012E¯10

28 *PRNT ITOS*

Bluefield, WV			Baseline, Day 154			Baseline, Day 188		
4.2838E¯03	3.1134E¯03	5.6612E¯03	1.1134E¯03	1.5423E¯03	1.4380E¯03	5.6090E¯04	6.5502E¯04	8.4849E¯04
1.9906E¯02	1.7555E¯02	1.9036E¯02	1.5079E¯02	1.5764E¯02	1.4990E¯02	8.3104E¯03	8.3000E¯03	9.4546E¯03
1.8379E¯02	1.9947E¯02	1.1512E¯02	2.8592E¯02	2.8731E¯02	2.9470E¯02	2.0484E¯02	1.8351E¯02	1.9042E¯02
¯8.1899E¯03	¯1.1227E¯02	¯4.4103E¯03	¯1.7382E¯02	¯1.7723E¯02	¯1.7847E¯02	¯5.2301E¯03	¯3.1031E¯03	¯4.4633E¯03
6.9522E¯03	8.3787E¯03	5.8737E¯03	1.4649E¯02	1.5772E¯02	1.5701E¯02	8.8847E¯03	7.7594E¯03	8.9113E¯03
¯2.2686E¯03	¯2.5971E¯03	¯2.0681E¯03	¯5.1223E¯03	¯5.6141E¯03	¯5.5773E¯03	¯3.7176E¯03	¯3.4101E¯03	¯3.8036E¯03
3.7859E¯04	4.2357E¯04	3.5463E¯04	9.2581E¯04	1.0213E¯03	1.0133E¯03	7.1714E¯04	6.6943E¯04	7.3092E¯04
¯3.6835E¯05	¯4.0686E¯05	¯3.5059E¯05	¯9.6544E¯05	¯1.0660E¯04	¯1.0562E¯04	¯7.6804E¯05	¯7.2377E¯05	¯7.9653E¯05
2.1135E¯06	2.3161E¯06	2.0359E¯06	5.8610E¯06	6.4591E¯06	6.3913E¯06	4.7098E¯06	4.4658E¯06	4.9015E¯06
¯6.6153E¯08	¯7.2143E¯08	¯6.4351E¯08	¯1.9206E¯07	¯2.1100E¯07	¯2.0851E¯07	¯1.5470E¯07	¯1.4734E¯07	¯1.6139E¯07
8.6949E¯10	9.4567E¯10	8.5289E¯10	2.6226E¯09	2.8712E¯09	2.8339E¯09	2.1100E¯09	2.0162E¯09	2.2048E¯09

Table D-8

Polynomial Coefficients for I Data Taken at Field Sites

1 PRNT ITVS

Wilmington, NC			Emporia, VA			Towanda, PA		
2.4853E¯03	2.5646E¯03	2.3592E¯03	1.6893E¯03	1.4032E¯03	1.6988E¯03	1.6060E¯03	6.7895E¯04	1.7228E¯03
1.4024E¯02	1.4122E¯02	1.3983E¯02	1.5329E¯02	1.4421E¯02	1.5201E¯02	1.2298E¯02	8.3556E¯03	1.2695E¯02
1.7032E¯02	1.6789E¯02	1.7641E¯02	2.4689E¯02	2.4353E¯02	2.3387E¯02	1.9738E¯02	2.3201E¯02	2.0590E¯02
¯2.0582E¯03	¯1.7958E¯03	¯2.9273E¯03	¯8.1516E¯03	¯8.7060E¯03	¯7.6938E¯03	¯5.6976E¯03	¯8.5796E¯03	¯8.1551E¯03
7.3477E¯03	7.2077E¯03	7.6055E¯03	9.7695E¯03	9.7663E¯03	9.4379E¯03	7.4970E¯03	8.4347E¯03	8.4910E¯03
¯3.4020E¯03	¯3.3630E¯03	¯3.4420E¯03	¯3.9279E¯03	¯3.8499E¯03	¯3.7985E¯03	¯2.9299E¯03	¯3.2189E¯03	¯3.2703E¯03
6.8541E¯04	6.7922E¯04	6.8825E¯04	7.6165E¯04	7.3944E¯04	7.3557E¯04	5.5621E¯04	6.0750E¯04	6.2150E¯04
¯7.5355E¯05	¯7.4769E¯05	¯7.5371E¯05	¯8.3068E¯05	¯8.0169E¯05	¯8.0108E¯05	¯5.9544E¯05	¯6.4858E¯05	¯6.6805E¯05
4.7050E¯06	4.6721E¯06	4.6943E¯06	5.2042E¯06	5.0027E¯06	5.0133E¯06	3.6680E¯06	3.9860E¯06	4.1317E¯06
¯1.5661E¯07	¯1.5560E¯07	¯1.5599E¯07	¯1.7450E¯07	¯1.6730E¯07	¯1.6798E¯07	¯1.2111E¯07	¯1.3132E¯07	¯1.3689E¯07
2.1580E¯09	2.1450E¯09	2.1467E¯09	2.4241E¯09	2.3198E¯09	2.3325E¯09	1.6589E¯09	1.7350E¯09	1.8804E¯09

10 PRNT ITVS

Dexter, NY			Danville, IN			Marietta, OH		
2.9189E¯03	3.2075E¯03	3.7845E¯03	8.0026E¯04	7.1190E¯04	6.8315E¯04	¯1.1644E¯02	¯1.0571E¯02	¯1.0551E¯02
7.1631E¯03	5.8661E¯03	5.0598E¯03	1.0275E¯02	9.9395E¯03	9.8966E¯03	¯1.6312E¯04	¯1.4095E¯03	¯1.4920E¯03
1.0356E¯03	2.5326E¯03	3.2425E¯03	2.7090E¯02	2.7835E¯02	2.8496E¯02	¯1.2031E¯02	¯1.1308E¯02	¯1.1356E¯02
6.5915E¯03	5.6667E¯03	5.1130E¯03	¯8.7530E¯03	¯9.0628E¯03	¯9.6061E¯03	¯8.1263E¯03	¯8.1786E¯03	¯8.0438E¯03
¯1.1274E¯03	¯8.0532E¯04	¯5.1603E¯04	7.6500E¯03	7.7273E¯03	7.9475E¯03	1.4480E¯03	1.3524E¯03	1.2760E¯03
¯2.2265E¯04	¯2.9316E¯04	¯3.7974E¯04	¯2.8835E¯03	¯2.9000E¯03	¯2.9513E¯03	2.7690E¯04	3.1534E¯04	3.3672E¯04
9.4874E¯05	1.0471E¯04	1.1980E¯04	5.4991E¯04	5.5280E¯04	5.6016E¯04	¯1.1722E¯04	¯1.2406E¯04	¯1.2738E¯04
¯1.3485E¯05	¯1.4348E¯05	¯1.5912E¯05	¯5.9932E¯05	¯6.0267E¯05	¯6.0929E¯05	1.6741E¯05	1.7411E¯05	1.7707E¯05
9.7392E¯07	1.0198E¯06	1.1148E¯06	3.7694E¯06	3.7922E¯06	3.8285E¯06	¯1.2148E¯06	¯1.2522E¯06	¯1.2671E¯06
¯3.5734E¯08	¯3.7086E¯08	¯4.0211E¯08	¯1.2689E¯07	¯1.2771E¯07	¯1.2882E¯07	4.4505E¯08	4.5625E¯08	4.6025E¯08
5.2822E¯10	5.4519E¯10	5.8813E¯10	1.7670E¯09	1.7791E¯09	1.7935E¯09	¯6.5219E¯10	¯6.6615E¯10	¯6.7056E¯10

19 PRNT ITVS

Georgetown, DE			Toms River, NJ			Grottoes, VA		
2.1619E¯03	3.0979E¯03	3.7308E¯03	4.2881E¯03	4.9403E¯03	4.8674E¯03	7.3645E¯03	7.6356E¯03	7.1943E¯03
2.0462E¯03	6.0207E¯04	¯8.1864E¯04	1.5901E¯02	1.8273E¯02	1.8563E¯02	3.3444E¯03	3.1567E¯03	3.4301E¯03
4.5906E¯03	4.6532E¯03	5.2180E¯03	1.4668E¯02	1.6127E¯02	1.6758E¯02	7.5294E¯03	8.3657E¯03	8.6403E¯03
2.8346E¯03	3.3746E¯03	3.7270E¯03	1.9415E¯03	8.5978E¯04	5.5314E¯04	3.6038E¯03	3.5853E¯03	3.1610E¯03
¯6.8058E¯04	¯9.2968E¯04	¯1.2209E¯03	2.5311E¯03	3.2003E¯03	3.3442E¯03	¯7.1438E¯04	¯8.7992E¯04	¯7.1848E¯04
¯6.5055E¯06	4.0090E¯05	1.3128E¯04	¯1.3075E¯03	¯1.5537E¯03	¯1.5946E¯03	¯4.6293E¯05	3.0014E¯05	¯3.0080E¯05
2.1532E¯05	1.7926E¯05	1.5440E¯06	2.5787E¯04	3.0525E¯04	3.1214E¯04	2.9591E¯05	1.3432E¯05	1.7479E¯05
¯3.6873E¯06	¯3.6955E¯06	¯1.9228E¯06	¯2.7733E¯05	¯3.2967E¯05	¯3.3673E¯05	¯4.5160E¯06	¯2.6508E¯06	¯2.9484E¯06
2.9357E¯07	3.1244E¯07	1.9950E¯07	1.7119E¯06	2.0444E¯06	2.0875E¯06	3.4597E¯07	2.2496E¯07	2.3758E¯07
¯1.1459E¯08	¯1.2555E¯08	¯8.6672E¯09	¯5.6735E¯08	¯6.8004E¯08	¯6.9447E¯08	¯1.3355E¯08	¯9.1981E¯09	¯9.4772E¯09
1.7614E¯10	1.9638E¯10	1.4066E¯10	7.8093E¯10	9.3877E¯10	9.5901E¯10	2.0566E¯10	1.4669E¯10	1.4911E¯10

28 PRNT ITVS

Bluefield, WV			Baseline, Day 154			Baseline, Day 188		
4.8293E¯04	5.0214E¯04	5.2014E¯04	1.6840E¯03	1.9950E¯03	2.4890E¯03	5.0787E¯04	3.8210E¯03	6.7305E¯04
5.7785E¯03	5.5543E¯03	5.5717E¯03	1.4593E¯02	1.5639E¯02	1.6152E¯02	8.8654E¯03	¯3.0587E¯02	1.0010E¯02
1.6323E¯02	1.4822E¯02	1.4034E¯02	2.3422E¯02	2.3193E¯02	1.9372E¯02	2.5908E¯02	7.0694E¯02	2.6145E¯02
¯8.0339E¯03	¯7.0956E¯03	¯6.4674E¯03	¯1.1913E¯02	¯1.1819E¯02	¯8.5956E¯03	¯1.1306E¯02	¯5.5011E¯02	¯1.2396E¯02
2.3690E¯03	1.9922E¯03	1.8280E¯03	1.0904E¯02	1.1529E¯02	1.0321E¯02	1.1718E¯02	3.0307E¯02	1.2562E¯02
¯2.2030E¯04	¯1.2859E¯04	¯1.1620E¯04	¯3.9276E¯03	¯4.2136E¯03	¯3.9679E¯03	¯4.4490E¯03	¯8.6081E¯03	¯4.7805E¯03
¯2.6022E¯05	¯3.9040E¯05	¯3.6880E¯05	7.1897E¯04	7.7315E¯04	7.4348E¯04	8.3075E¯04	1.3763E¯03	8.9221E¯04
7.3752E¯06	8.4655E¯06	7.9271E¯06	¯7.5627E¯05	¯8.1103E¯05	¯7.8914E¯05	¯8.7626E¯05	¯1.3094E¯04	¯9.4162E¯05
¯6.4783E¯07	¯7.0036E¯07	¯6.5439E¯07	4.6247E¯06	4.9348E¯06	4.8387E¯06	5.3262E¯06	7.3663E¯06	5.7267E¯06
2.6071E¯08	2.7462E¯08	2.5595E¯08	¯1.5250E¯07	¯1.6179E¯07	¯1.5952E¯07	¯1.7392E¯07	¯2.2614E¯07	¯1.8707E¯07
¯4.0750E¯10	¯4.2257E¯10	¯3.9352E¯10	2.0934E¯09	2.2082E¯09	2.1865E¯09	2.3616E¯09	2.9184E¯09	2.5403E¯09

Table D-9

Polynomial Coefficients for Q Data Taken at NAVOBSY

1 *PRNT QTO3*

Wilmington, NC			Emporia, VA			Towanda, PA		
¯1.2595E¯03	¯9.3945E¯04	¯1.5598E¯03	¯4.1563E¯03	¯6.1338E¯03	¯5.6897E¯03	¯1.8711E¯03	¯1.4140E¯03	¯1.5735E¯03
¯7.2011E¯03	¯6.6493E¯03	¯7.0722E¯03	¯9.4123E¯03	¯5.0188E¯03	¯5.8593E¯03	¯1.1442E¯02	¯1.1357E¯02	¯1.1188E¯02
¯7.5490E¯03	¯9.3151E¯03	¯5.2996E¯03	¯8.7409E¯04	¯6.4841E¯04	¯7.8373E¯04	¯1.2846E¯02	¯1.7849E¯02	¯1.5260E¯02
6.8466E¯03	8.1224E¯03	4.2266E¯03	2.4433E¯05	¯2.9196E¯03	¯2.4983E¯03	1.3142E¯02	1.8959E¯02	1.5500E¯02
¯2.3798E¯03	¯3.2981E¯03	¯1.6024E¯03	4.6916E¯04	2.3062E¯03	2.1199E¯03	¯5.0605E¯03	¯7.9039E¯03	¯6.1156E¯03
1.0460E¯03	1.1196E¯03	7.0524E¯04	1.5970E¯04	¯3.8544E¯04	¯3.4501E¯04	1.4061E¯03	2.1574E¯03	1.6555E¯03
¯2.2189E¯04	¯2.2927E¯04	¯1.6798E¯04	¯7.9812E¯05	1.1602E¯05	1.1456E¯06	¯2.5277E¯04	¯3.7032E¯04	¯2.8748E¯04
2.5638E¯05	2.6264E¯05	2.0666E¯05	1.1797E¯05	2.6824E¯06	2.8761E¯06	2.7129E¯05	3.8337E¯05	3.0059E¯05
¯1.6712E¯06	¯1.6351E¯06	¯1.3762E¯06	¯8.4573E¯07	¯3.0911E¯07	¯3.0480E¯07	¯1.5845E¯06	¯2.3241E¯06	¯1.8321E¯06
5.6872E¯08	5.7112E¯08	4.7670E¯08	3.0594E¯08	1.3336E¯08	1.2684E¯08	5.6100E¯08	7.6193E¯08	6.0180E¯08
¯7.9822E¯10	¯8.0015E¯10	¯6.7740E¯10	¯4.5080E¯10	¯2.1685E¯10	¯2.0121E¯10	¯7.7782E¯10	¯1.0450E¯09	¯8.2543E¯10

10 *PRNT QTO3*

Dexter, NY			Danville, IN			Marietta, OH		
¯2.3977E¯03	¯3.2992E¯05	¯2.6228E¯05	1.3167E¯04	4.1657E¯05	¯4.4961E¯04	¯1.3971E¯03	¯1.3402E¯03	¯2.0973E¯03
¯6.2160E¯03	¯4.3453E¯03	¯4.3246E¯03	¯1.6743E¯07	1.7143E¯03	5.2563E¯03	¯5.7159E¯03	¯5.5634E¯03	¯5.0268E¯03
¯1.9243E¯03	¯1.7291E¯02	¯1.7069E¯02	¯6.4241E¯03	¯1.1940E¯02	¯1.6126E¯02	¯2.0484E¯04	¯4.3191E¯04	1.3716E¯03
1.9626E¯04	1.6445E¯02	1.6222E¯02	6.5836E¯03	1.1946E¯02	1.4085E¯02	5.1187E¯03	5.4122E¯03	2.8105E¯03
2.9243E¯04	¯7.1578E¯03	¯7.0523E¯03	¯2.8677E¯03	¯5.3621E¯03	¯5.9205E¯03	¯3.3877E¯03	¯3.5592E¯03	¯2.1576E¯03
2.2240E¯04	2.0421E¯03	2.0088E¯03	7.0277E¯04	1.3540E¯03	1.4260E¯03	1.0573E¯03	1.1044E¯03	7.1296E¯04
¯9.5429E¯05	¯3.5441E¯04	¯3.4758E¯04	¯1.0556E¯04	¯2.0777E¯04	¯2.1034E¯04	¯1.8670E¯04	¯1.9358E¯04	¯1.3042E¯04
1.4027E¯05	3.6197E¯05	3.5334E¯05	9.9514E¯06	1.9784E¯05	1.9363E¯05	1.9644E¯05	2.0208E¯05	1.4079E¯05
¯1.0110E¯06	¯2.1341E¯06	¯2.0704E¯06	¯5.7343E¯07	¯1.1404E¯06	¯1.0840E¯06	¯1.2193E¯06	¯1.2445E¯06	¯8.9114E¯07
3.6540E¯08	6.7495E¯08	6.5003E¯08	1.8395E¯08	3.6378E¯08	3.3792E¯08	4.1167E¯08	4.1702E¯08	3.0542E¯08
¯5.3284E¯10	¯8.8967E¯10	¯8.4973E¯10	¯2.5097E¯10	¯4.9211E¯10	¯4.4825E¯10	¯5.8250E¯10	¯5.8585E¯10	¯4.3710E¯10

19 *PRNT QTO3*

Georgetown, DE			Toms River, NJ			Grottoes, VA		
¯3.2012E¯04	1.2297E¯04	1.1035E¯04	¯7.2701E¯03	¯1.7337E¯03	¯3.0336E¯03	¯4.6661E¯03	¯5.4345E¯03	¯5.6495E¯03
9.6951E¯04	¯1.1357E¯03	¯1.4324E¯03	¯5.3261E¯03	¯1.4036E¯02	¯1.4029E¯02	¯9.8001E¯03	¯9.7031E¯03	¯1.2712E¯02
¯7.5819E¯03	¯6.4775E¯03	¯5.1032E¯03	5.3940E¯04	¯2.0236E¯02	¯7.2593E¯03	2.4551E¯04	7.5153E¯04	1.0289E¯03
9.0407E¯03	9.0412E¯03	7.9149E¯03	4.7802E¯04	3.1255E¯02	1.8565E¯02	4.4590E¯03	3.4765E¯03	7.2440E¯03
¯4.6942E¯03	¯4.8123E¯03	¯4.4061E¯03	1.3905E¯04	¯1.5993E¯02	¯1.1048E¯02	¯2.5680E¯03	¯1.9465E¯03	¯4.7855E¯03
1.3206E¯03	1.3529E¯03	1.2710E¯03	¯1.4015E¯05	4.3855E¯03	3.3998E¯03	8.3526E¯04	6.5314E¯04	1.5632E¯03
¯2.1864E¯04	¯2.2255E¯04	¯2.1225E¯04	¯6.7612E¯06	¯7.0602E¯04	¯5.9727E¯04	¯1.5818E¯04	¯1.2844E¯04	¯2.8759E¯04
2.1961E¯05	2.2202E¯05	2.1368E¯05	1.4186E¯06	6.8550E¯05	6.2024E¯05	1.7584E¯05	1.4697E¯05	3.1022E¯05
¯1.3150E¯06	¯1.3221E¯06	¯1.2795E¯06	¯1.1670E¯07	¯3.9508E¯06	¯3.7725E¯06	¯1.1369E¯06	¯9.7095E¯07	¯1.9524E¯06
4.3125E¯08	4.3181E¯08	4.1933E¯08	4.6380E¯09	1.2455E¯07	1.2437E¯07	3.9577E¯08	3.4450E¯08	6.6495E¯08
¯5.9548E¯10	¯5.9462E¯10	¯5.7860E¯10	¯7.3987E¯11	¯1.6540E¯09	¯1.7169E¯09	¯5.7819E¯10	¯5.0900E¯10	¯9.4766E¯10

28 *PRNT QTO3*

Bluefield, WV			Baseline, Day 154			Baseline, Day 188		
¯3.6094E¯03	¯2.2994E¯03	¯2.4392E¯03	¯6.6624E¯03	¯5.1991E¯03	¯4.1849E¯03	¯4.2614E¯03	¯4.2684E¯03	¯4.5071E¯03
¯6.9975E¯03	¯6.3985E¯03	¯4.7182E¯03	¯3.3988E¯03	¯7.2804E¯03	¯8.1927E¯03	¯1.2787E¯02	¯1.2531E¯02	¯1.2140E¯02
¯2.5307E¯03	¯2.5559E¯03	¯2.0848E¯03	¯2.2263E¯03	¯7.3886E¯04	¯1.4523E¯03	¯6.4460E¯03	¯6.6188E¯03	¯6.2010E¯03
1.0008E¯03	1.9859E¯03	6.7751E¯04	¯2.3593E¯03	¯2.0827E¯03	¯1.0204E¯03	3.0929E¯03	2.9056E¯03	1.8014E¯03
1.1940E¯03	3.1250E¯04	9.1007E¯04	2.3698E¯03	1.8945E¯03	1.3784E¯03	6.8409E¯04	9.4243E¯04	1.5572E¯03
¯5.3631E¯04	¯2.5950E¯04	¯3.8843E¯04	¯4.7708E¯04	¯2.6628E¯04	¯1.3168E¯04	¯1.6756E¯04	¯2.8325E¯04	¯4.2910E¯04
9.9291E¯05	5.2931E¯05	6.8031E¯05	3.5914E¯05	¯1.0074E¯05	¯3.0451E¯05	¯2.6325E¯06	2.2812E¯05	4.0826E¯05
¯1.0076E¯05	¯5.4613E¯06	¯6.4104E¯06	¯4.7926E¯07	5.0238E¯06	6.8456E¯06	2.4049E¯06	¯6.1672E¯07	¯1.7963E¯06
5.8164E¯07	3.0773E¯07	3.3428E¯07	¯8.3269E¯08	¯4.5274E¯07	¯5.4706E¯07	¯2.0311E¯07	1.1586E¯08	4.5862E¯08
¯1.7829E¯08	¯8.8787E¯09	¯8.8727E¯09	4.8433E¯09	1.7941E¯08	2.0540E¯08	6.6003E¯09	¯1.3183E¯09	¯1.3053E¯09
2.2445E¯10	1.0059E¯10	8.9864E¯11	¯8.5385E¯11	¯2.7664E¯10	¯3.0585E¯10	¯7.6501E¯11	4.4438E¯11	2.9298E¯11

Table D-10

Polynomial Coefficients for I Data Taken at Field Sites

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          Wilmington, NC                      Emporia, VA                        Towanda, PA
    1 PRNT QTV3
¯3.7641E¯03 ¯3.7700E¯03 ¯3.7418E¯03 ¯6.1952E¯03 ¯5.9527E¯03 ¯6.1631E¯03 ¯1.1499E¯04 ¯1.3261E¯04 ¯1.0949E¯03
¯7.2934E¯03 ¯7.2705E¯03 ¯7.0812E¯03 ¯8.2006E¯03 ¯7.5142E¯03 ¯7.3999E¯03 ¯3.1545E¯03 ¯3.2564E¯03 ¯7.3883E¯03
¯3.2727E¯03 ¯3.2072E¯03 ¯3.1576E¯03 ¯8.3854E¯04 ¯9.1415E¯04 ¯1.1034E¯03 ¯1.6722E¯02 ¯1.6865E¯02 ¯8.2573E¯03
 4.3767E¯04  4.3905E¯04  3.0173E¯04 ¯4.2784E¯04 ¯5.1266E¯04 ¯5.8810E¯04  1.9758E¯02  1.9311E¯02  1.3210E¯02
 1.3034E¯03  1.2541E¯03  1.3386E¯03  9.1858E¯04  9.1587E¯04  1.0499E¯03 ¯9.8916E¯03 ¯9.5702E¯03 ¯7.2076E¯03
¯3.5106E¯04 ¯3.2496E¯04 ¯3.5548E¯04 ¯3.8374E¯05 ¯3.2238E¯05 ¯8.2203E¯05  2.8137E¯03  2.7493E¯03  2.1737E¯03
 3.6801E¯05  3.0863E¯05  3.7097E¯05 ¯3.7294E¯05 ¯3.8478E¯05 ¯2.9220E¯05 ¯4.6745E¯04 ¯4.6327E¯04 ¯3.7403E¯04
¯2.0094E¯06 ¯1.2914E¯06 ¯2.0182E¯06  6.7718E¯06  6.8696E¯06  5.8941E¯06  4.6011E¯05  4.6221E¯05  3.7583E¯05
 5.9286E¯08  2.0990E¯08  6.9263E¯08 ¯5.0744E¯07 ¯5.1046E¯07 ¯4.5107E¯07 ¯2.6480E¯06 ¯2.6920E¯06 ¯2.1908E¯06
¯1.8175E¯09 ¯1.0803E¯10 ¯1.8135E¯09  1.8380E¯08  1.8346E¯08  1.6399E¯08  8.2509E¯08  8.4827E¯08  6.8853E¯08
 2.8343E¯11  3.4716E¯12  2.8385E¯11 ¯2.6710E¯10 ¯2.6439E¯10 ¯2.3777E¯10 ¯1.0769E¯09 ¯1.1181E¯09 ¯9.0427E¯10

             Dexter, NY                      Danville, IN                       Marietta, OH
    10 PRNT QTV3
¯6.2831E¯03 ¯3.4243E¯03 ¯1.3055E¯03 ¯4.1384E¯03 ¯4.2444E¯03 ¯4.2311E¯03  2.0922E¯03  1.4298E¯03  2.3952E¯03
 2.3219E¯02  1.3385E¯02  5.7550E¯03 ¯1.5460E¯02 ¯1.5720E¯02 ¯1.5671E¯02  1.0804E¯02  1.0074E¯02  1.0814E¯02
¯3.5226E¯02 ¯2.1985E¯02 ¯1.1973E¯02 ¯5.6092E¯03 ¯5.5312E¯03 ¯5.5220E¯03  6.6421E¯03  9.4555E¯03  5.4246E¯03
 2.6210E¯02  1.7313E¯02  1.0941E¯02  1.4910E¯02  1.5042E¯02  1.4949E¯02 ¯1.1057E¯02 ¯1.4237E¯02 ¯1.0444E¯02
¯1.0981E¯02 ¯7.6371E¯03 ¯5.3461E¯03 ¯7.7047E¯03 ¯7.8105E¯03 ¯7.7495E¯03  5.4484E¯03  6.4267E¯03  4.7543E¯03
 2.7559E¯03  2.0071E¯03  1.5030E¯03  2.0768E¯03  2.1129E¯03  2.0961E¯03 ¯1.3455E¯03 ¯1.5767E¯03 ¯1.1630E¯03
¯4.2151E¯04 ¯3.1794E¯04 ¯2.4778E¯04 ¯3.3133E¯04 ¯3.3807E¯04 ¯3.3552E¯04  1.9958E¯04  2.3284E¯04  1.7137E¯04
 3.9397E¯05  3.0451E¯05  2.4263E¯05  3.2288E¯05  3.3023E¯05  3.2793E¯05 ¯1.8293E¯05 ¯2.1251E¯05 ¯1.5652E¯05
¯2.1948E¯06 ¯1.7245E¯06 ¯1.3897E¯06 ¯1.8870E¯06 ¯1.9337E¯06 ¯1.9215E¯06  1.0157E¯06  1.1744E¯06  8.6850E¯07
 6.6953E¯08  5.3181E¯08  4.3050E¯08  6.0710E¯08  6.2314E¯08  6.1964E¯08 ¯3.1290E¯08 ¯3.6000E¯08 ¯2.6794E¯08
¯8.6145E¯10 ¯6.8887E¯10 ¯5.5772E¯10 ¯8.2585E¯10 ¯9.4885E¯10 ¯8.4463E¯10  4.0973E¯10  4.6912E¯10  3.5182E¯10

          Georgetown, DE                      Toms River, NJ                     Grottoes, VA
    19 PRNT QTV3
¯1.2320E¯03 ¯1.1425E¯03 ¯7.8471E¯04 ¯4.9479E¯03 ¯6.3956E¯03 ¯6.5798E¯03 ¯1.1918E¯03 ¯1.0722E¯03 ¯1.3067E¯03
¯2.5313E¯03 ¯2.7641E¯03 ¯1.9439E¯03 ¯1.2060E¯02 ¯1.2196E¯02 ¯1.2401E¯02 ¯2.6274E¯03 ¯3.2372E¯03 ¯3.1486E¯03
 7.4381E¯04 ¯3.9741E¯04 ¯2.5150E¯03 ¯1.2447E¯03  4.1599E¯04  5.6093E¯04 ¯7.9881E¯04 ¯2.5648E¯03 ¯7.4099E¯04
 2.5442E¯03  3.8750E¯03  5.6036E¯03  6.2128E¯03  4.5194E¯03  4.5372E¯03  3.3941E¯03  5.9518E¯03  3.4239E¯03
¯2.1337E¯03 ¯2.7467E¯03 ¯3.4795E¯03 ¯3.1653E¯03 ¯2.4544E¯03 ¯2.5083E¯03 ¯2.1259E¯03 ¯3.4637E¯03 ¯2.1052E¯03
 7.3475E¯04  8.8782E¯04  1.0706E¯03  9.6947E¯04  8.3392E¯04  8.5997E¯04  6.4495E¯04  1.0118E¯03  6.3674E¯04
¯1.3512E¯04 ¯1.5747E¯04 ¯1.8534E¯04 ¯1.7811E¯04 ¯1.6620E¯04 ¯1.7191E¯04 ¯1.1042E¯04 ¯1.6878E¯04 ¯1.0923E¯04
 1.4411E¯05  1.6382E¯05  1.9003E¯05  1.9369E¯05  1.9124E¯05  1.9797E¯05  1.1197E¯05  1.6785E¯05  1.1093E¯05
¯8.9477E¯07 ¯9.9844E¯07 ¯1.1467E¯06 ¯1.2275E¯06 ¯1.2630E¯06 ¯1.3077E¯06 ¯6.6788E¯07 ¯9.8568E¯07 ¯6.6129E¯07
 3.0011E¯08  3.3014E¯08  3.7638E¯08  4.2032E¯08  4.4658E¯08  4.6230E¯08  2.1676E¯08  3.1577E¯08  2.1412E¯08
¯4.2024E¯10 ¯4.5712E¯10 ¯5.1816E¯10 ¯6.0174E¯10 ¯6.5610E¯10 ¯6.7909E¯10 ¯2.9552E¯10 ¯4.2570E¯10 ¯2.9085E¯10

          Bluefield, WV                    Baseline, Day 154                 Baseline, Day 188
    28 PRNT QTV3
 8.2150E¯04  1.3777E¯03  1.0241E¯03 ¯4.2447E¯03 ¯3.7031E¯03 ¯3.7568E¯03 ¯3.7975E¯03  2.5585E¯04 ¯4.0051E¯03
 4.5061E¯03  5.4372E¯03  4.8024E¯03 ¯6.3608E¯03 ¯7.7941E¯03 ¯5.8637E¯03 ¯1.2837E¯02 ¯4.5564E¯03 ¯1.2651E¯02
 2.2805E¯03  7.8364E¯04  1.6714E¯03 ¯4.2965E¯04 ¯1.2212E¯03 ¯1.7341E¯03 ¯5.8402E¯03 ¯1.0630E¯02 ¯5.3681E¯03
¯1.0723E¯02 ¯9.0317E¯03 ¯9.2207E¯03 ¯2.6884E¯04  1.7976E¯03  7.1514E¯05  5.1074E¯03  5.8379E¯03  4.0391E¯03
 6.9507E¯03  6.0065E¯03  5.9293E¯03  5.4536E¯04 ¯8.5341E¯04  5.6958E¯04 ¯1.3000E¯03 ¯1.4208E¯03 ¯6.2147E¯04
¯1.9779E¯03 ¯1.7129E¯03 ¯1.6770E¯03  2.2357E¯05  5.0684E¯04  2.5180E¯05  5.2820E¯04  5.3175E¯04  3.2467E¯04
 3.0844E¯04  2.6579E¯04  2.6069E¯04 ¯3.2934E¯05 ¯1.2635E¯04 ¯3.7772E¯05 ¯1.3087E¯04 ¯1.2116E¯04 ¯9.6477E¯05
¯2.8201E¯05 ¯2.4050E¯05 ¯2.3745E¯05  4.8205E¯06  1.5243E¯05  5.6931E¯06  1.6223E¯05  1.4037E¯05  1.2775E¯05
 1.5053E¯06  1.2634E¯06  1.2590E¯06 ¯3.0689E¯07 ¯9.7726E¯07 ¯3.7425E¯07 ¯1.0031E¯06 ¯8.6850E¯07 ¯8.6033E¯07
¯4.3343E¯08 ¯3.5500E¯08 ¯3.5870E¯08  9.3225E¯09  3.2419E¯08  1.1781E¯08  3.5783E¯08  2.7819E¯08  2.9319E¯08
 5.1901E¯10  4.1351E¯10  4.2293E¯10 ¯1.1088E¯10 ¯4.4129E¯10 ¯1.4573E¯10 ¯4.9111E¯10 ¯3.6608E¯10 ¯4.0494E¯10
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Table D-11

Polynomial Coefficients for Q Data Taken at NAVOBSY

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          Wilmington, NC                             Emporia, VA                               Towanda, PA
     1 PRNT ITO3
 2.4291E¯03  2.5956E¯03  2.3325E¯03   2.5870E¯03  3.1089E¯03  3.4133E¯03   2.0967E¯03  1.5872E¯03  1.9336E¯03
 1.7483E¯02  1.7646E¯02  1.7234E¯02   1.9212E¯02  1.8995E¯02  1.9733E¯02   1.5539E¯02  1.4625E¯02  1.5383E¯02
 2.6444E¯02  2.5040E¯02  2.7012E¯02   3.4213E¯02  2.9847E¯02  2.7925E¯02   2.5312E¯02  2.8306E¯02  2.7004E¯02
¯1.4750E¯02 ¯1.3223E¯02 ¯1.5709E¯02  ¯1.9209E¯02 ¯1.6046E¯02 ¯1.3740E¯02  ¯1.0340E¯02 ¯1.2135E¯02 ¯1.1637E¯02
 1.4914E¯02  1.4161E¯02  1.5349E¯02   1.6043E¯02  1.4408E¯02  1.3424E¯02   1.1517E¯02  1.2090E¯02  1.2047E¯02
¯5.6551E¯03 ¯5.4507E¯03 ¯5.7564E¯03  ¯5.8160E¯03 ¯5.3353E¯03 ¯5.1104E¯03  ¯4.5593E¯03 ¯4.6618E¯03 ¯4.6852E¯03
 1.0630E¯03  1.0304E¯03  1.0771E¯03   1.0850E¯03  1.0031E¯03  9.7253E¯04   8.7767E¯04  8.8905E¯04  8.9582E¯04
¯1.1278E¯04 ¯1.0968E¯04 ¯1.1402E¯04  ¯1.1582E¯04 ¯1.0747E¯04 ¯1.0494E¯04  ¯9.4658E¯05 ¯9.5453E¯05 ¯9.6247E¯05
 6.8834E¯06  6.7112E¯06  6.9510E¯06   7.1488E¯06  6.5479E¯06  6.5227E¯06   5.8426E¯06  5.8764E¯06  5.9246E¯06
¯2.2549E¯07 ¯2.2030E¯07 ¯2.2759E¯07  ¯2.3713E¯07 ¯2.2084E¯07 ¯2.1744E¯07  ¯1.9273E¯07 ¯1.9353E¯07 ¯1.9501E¯07
 3.0714E¯09  3.0059E¯09  3.0994E¯09   3.2693E¯09  3.0480E¯09  3.0089E¯09   2.6348E¯09  2.6428E¯09  2.6610E¯09
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           Dexter, NY                                Danville, IN                              Marietta, OH
    10 PRNT ITO3
 3.1138E¯03  3.8236E¯03  4.0852E¯03   5.2051E¯03  6.5397E¯03  8.3438E¯03   4.2155E¯03  3.2684E¯03  2.8232E¯03
 1.8751E¯02  1.7838E¯02  1.8399E¯02  ¯2.7455E¯02 ¯3.0551E¯02 ¯3.8323E¯02  ¯2.2331E¯02 ¯1.7975E¯02 ¯1.6159E¯02
 2.3392E¯02  1.8321E¯02  1.7836E¯02   4.2814E¯02  4.2091E¯02  5.3140E¯02   3.4135E¯02  2.7870E¯02  2.5807E¯02
¯1.3309E¯02 ¯5.1955E¯03 ¯5.3943E¯03  ¯1.9214E¯02 ¯1.6695E¯02 ¯2.3389E¯02  ¯1.2129E¯02 ¯8.1535E¯03 ¯6.9601E¯03
 1.4944E¯02  1.0082E¯02  1.0339E¯02   7.7028E¯03  6.3756E¯03  8.5767E¯03   4.8119E¯03  3.4403E¯03  3.0127E¯03
¯5.7676E¯03 ¯4.3037E¯03 ¯4.3894E¯03  ¯1.9589E¯03 ¯1.6196E¯03 ¯2.0544E¯03  ¯1.3088E¯03 ¯1.0241E¯03 ¯9.2580E¯04
 1.0884E¯03  8.3965E¯04  8.5382E¯04   3.0388E¯04  2.5409E¯04  3.0803E¯04   2.1641E¯04  1.7923E¯04  1.6496E¯04
¯1.1552E¯04 ¯9.0566E¯05 ¯9.1878E¯05  ¯2.9228E¯05 ¯2.4823E¯05 ¯2.9051E¯05  ¯2.2020E¯05 ¯1.8949E¯05 ¯1.7626E¯05
 7.0452E¯06  5.5793E¯06  5.6482E¯06   1.6955E¯06  1.4630E¯06  1.6659E¯06   1.3405E¯06  1.1851E¯06  1.1109E¯06
¯2.3051E¯07 ¯1.8387E¯07 ¯1.8578E¯07  ¯5.4034E¯08 ¯4.7283E¯08 ¯5.2716E¯08  ¯4.4457E¯08 ¯4.0075E¯08 ¯3.7771E¯08
 3.1356E¯09  2.5148E¯09  2.5365E¯09   7.2381E¯10  6.4068E¯10  7.0298E¯10   6.1559E¯10  5.6253E¯10  5.3216E¯10
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          Georgetown, DE                             Toms River, NJ                            Grottoes, VA
    19 PRNT ITO3
 7.9774E¯03 ¯5.0631E¯03 ¯5.2416E¯03   7.6183E¯03  1.9094E¯03  4.6896E¯03   8.0288E¯03  7.8997E¯03  4.4794E¯03
¯3.5167E¯02  3.6730E¯04  4.4732E¯04   1.5937E¯02  1.4919E¯02  2.1522E¯02   1.6530E¯02  1.7044E¯02  1.8839E¯02
 4.5715E¯02  7.5849E¯03  7.7746E¯03   9.3074E¯03  2.6882E¯02  1.9823E¯02   1.0028E¯02  1.0504E¯02  1.7151E¯02
¯1.7641E¯02  3.6629E¯03  3.6478E¯03   3.2649E¯03 ¯7.9491E¯03 ¯8.5312E¯03   3.7032E¯03  3.6017E¯03 ¯3.7406E¯03
 6.2934E¯03 ¯6.7430E¯04 ¯6.9007E¯04   1.6865E¯03  4.7640E¯03  7.2046E¯03   1.2811E¯03  1.3936E¯03  4.4507E¯03
¯1.5251E¯03 ¯1.1354E¯04 ¯1.0567E¯04  ¯1.0444E¯03 ¯1.3828E¯03 ¯2.3714E¯03  ¯8.8009E¯04 ¯9.3560E¯04 ¯1.6259E¯03
 2.3159E¯04  5.0542E¯05  4.8843E¯05   2.1402E¯04  2.0713E¯04  3.9637E¯04   1.8589E¯04  1.9498E¯04  2.8859E¯04
¯2.2173E¯05 ¯7.4651E¯06 ¯7.2651E¯06  ¯2.3480E¯05 ¯1.8110E¯05 ¯3.8332E¯05  ¯2.0766E¯05 ¯2.1755E¯05 ¯2.9572E¯05
 1.2948E¯06  5.6112E¯07  5.4766E¯07   1.4703E¯06  9.3948E¯07  2.1747E¯06   1.3243E¯06  1.3859E¯06  1.7793E¯06
¯4.1775E¯08 ¯2.1271E¯08 ¯2.0785E¯08  ¯4.9310E¯08 ¯2.5687E¯08 ¯6.7101E¯08  ¯4.5131E¯08 ¯4.7181E¯08 ¯5.8129E¯08
 5.6758E¯10  3.2189E¯10  3.1458E¯10   6.8594E¯10  3.1858E¯10  8.6827E¯10   6.3588E¯10  6.6424E¯10  7.9369E¯10
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          Bluefield, WV                           Baseline, Day 154                        Baseline, Day 188
    28 PRNT ITO3
 4.9969E¯03  3.5131E¯03  6.0837E¯03   3.0448E¯03  3.2154E¯03  2.8934E¯03   2.1604E¯03  2.2766E¯03  2.5874E¯03
 2.1302E¯02  1.8572E¯02  1.9708E¯02   1.7943E¯02  1.9482E¯02  1.8989E¯02   1.3924E¯02  1.3702E¯02  1.4851E¯02
 1.8343E¯02  1.9799E¯02  1.1546E¯02   2.8022E¯02  2.7828E¯02  2.8718E¯02   2.2420E¯02  2.0545E¯02  2.0979E¯02
¯7.8902E¯03 ¯1.1008E¯02 ¯4.1982E¯03  ¯1.5372E¯02 ¯1.5624E¯02 ¯1.5361E¯02  ¯4.7697E¯03 ¯2.7042E¯03 ¯3.6113E¯03
 6.6854E¯03  8.2227E¯03  5.7011E¯03   1.3635E¯02  1.4795E¯02  1.4829E¯02   8.2231E¯03  7.0490E¯03  7.9877E¯03
¯2.1894E¯03 ¯2.5541E¯03 ¯2.0200E¯03  ¯4.9501E¯03 ¯5.4770E¯03 ¯5.4692E¯03  ¯3.6220E¯03 ¯3.2837E¯03 ¯3.6330E¯03
 3.6633E¯04  4.1732E¯04  3.4767E¯04   9.1575E¯04  1.0206E¯03  1.0172E¯03   7.2093E¯04  6.6593E¯04  7.3185E¯04
¯3.5731E¯05 ¯4.0164E¯05 ¯3.4488E¯05  ¯9.6941E¯05 ¯1.0822E¯04 ¯1.0768E¯04  ¯7.8681E¯05 ¯7.3345E¯05 ¯8.0417E¯05
 2.0559E¯06  2.2915E¯06  2.0098E¯06   5.9451E¯06  6.6287E¯06  6.5844E¯06   4.8791E¯06  4.5710E¯06  5.0088E¯06
¯6.4546E¯08 ¯7.1562E¯08 ¯6.3769E¯08  ¯1.9626E¯07 ¯2.1830E¯07 ¯2.1649E¯07  ¯1.6133E¯07 ¯1.5162E¯07 ¯1.6612E¯07
 8.5121E¯10  9.4075E¯10  8.4857E¯10   2.6958E¯09  2.9905E¯09  2.9610E¯09   2.2094E¯09  2.0798E¯09  2.2798E¯09
```

Table D-12

Polynomial Coefficients for I Data Taken at Field Sites

```
            Wilmington, NC                          Emporia, VA                           Towanda, PA
    1 PRNT ITV3
 3.5647E¯03  3.6535E¯03  3.4320E¯03  3.5040E¯03  3.1713E¯03  3.5328E¯03  1.8981E¯03  9.1339E¯04  2.1765E¯03
 1.6411E¯02  1.6504E¯02  1.5364E¯02  1.8886E¯02  1.7875E¯02  1.8569E¯02  1.3623E¯02  9.9926E¯03  1.4717E¯02
 1.7705E¯02  1.7472E¯02  1.8241E¯02  2.4626E¯02  2.4254E¯02  2.3403E¯02  2.1682E¯02  2.5342E¯02  2.1402E¯02
¯1.3820E¯03 ¯1.1294E¯03 ¯2.1111E¯03 ¯7.0009E¯03 ¯7.5288E¯03 ¯6.5269E¯03 ¯8.7138E¯03 ¯1.0726E¯02 ¯9.3140E¯03
 6.7724E¯03  6.6421E¯03  7.0225E¯03  9.1555E¯03  9.1564E¯03  8.8039E¯03  8.5462E¯03  9.5541E¯03  9.2048E¯03
¯3.2798E¯03 ¯3.2455E¯03 ¯3.3192E¯03 ¯3.8534E¯03 ¯3.7794E¯03 ¯3.7175E¯03 ¯3.2519E¯03 ¯3.5711E¯03 ¯3.5179E¯03
 6.7473E¯04  6.6958E¯04  6.7757E¯04  7.6598E¯04  7.4404E¯04  7.3869E¯04  6.1309E¯04  6.7124E¯04  6.6839E¯04
¯7.5083E¯05 ¯7.4622E¯05 ¯7.5100E¯05 ¯8.4787E¯05 ¯8.1973E¯05 ¯8.1691E¯05 ¯6.5423E¯05 ¯7.1572E¯05 ¯7.1859E¯05
 4.7232E¯06  4.6988E¯06  4.7125E¯06  5.3622E¯06  5.1648E¯06  5.1620E¯06  4.0207E¯06  4.3950E¯06  4.4436E¯06
¯1.5800E¯07 ¯1.5729E¯07 ¯1.5737E¯07 ¯1.8100E¯07 ¯1.7388E¯07 ¯1.7413E¯07 ¯1.3252E¯07 ¯1.4471E¯07 ¯1.4719E¯07
 2.1847E¯09  2.1759E¯09  2.1732E¯09  2.5277E¯09  2.4239E¯09  2.4306E¯09  1.8130E¯09  1.9778E¯09  2.0219E¯09

               Dexter, NY                          Danville, IN                         Marietta, OH
    10 PRNT ITV3
 3.3941E¯03  3.4932E¯03  3.9217E¯03  1.2185E¯03  1.1391E¯03  1.1140E¯03 ¯1.1833E¯02 ¯1.0726E¯02 ¯1.0779E¯02
 5.7328E¯03  5.0751E¯03  4.7806E¯03  1.2019E¯02  1.1741E¯02  1.1731E¯02 ¯1.2441E¯03 ¯2.4403E¯03 ¯2.5804E¯03
 3.4623E¯03  4.1170E¯03  4.1343E¯03  2.7267E¯02  2.8001E¯02  2.8647E¯02 ¯1.2837E¯02 ¯1.2338E¯02 ¯1.2081E¯02
 4.9025E¯03  4.5376E¯03  4.4296E¯03 ¯9.4961E¯03 ¯9.8225E¯03 ¯1.0359E¯02 ¯7.2074E¯03 ¯7.0712E¯03 ¯7.2229E¯03
¯4.4665E¯04 ¯3.3317E¯04 ¯2.0685E¯04  8.0570E¯03  8.1466E¯03  8.3651E¯03  1.0669E¯03  8.9376E¯04  9.4338E¯04
¯3.9157E¯04 ¯4.1579E¯04 ¯4.6583E¯04 ¯3.0018E¯03 ¯3.0224E¯03 ¯3.0730E¯03  3.6847E¯04  4.2539E¯04  4.1569E¯04
 1.2076E¯04  1.2424E¯04  1.3417E¯04  5.7023E¯04  5.7386E¯04  5.8126E¯04 ¯1.3086E¯04 ¯1.4038E¯04 ¯1.3910E¯04
¯1.5924E¯05 ¯1.6242E¯05 ¯1.7346E¯05 ¯6.2049E¯05 ¯6.2465E¯05 ¯6.3136E¯05  1.8019E¯05  1.8931E¯05  1.8808E¯05
 1.1113E¯06  1.1208E¯06  1.1988E¯06  3.9008E¯06  3.9288E¯06  3.9659E¯06 ¯1.2881E¯06 ¯1.3387E¯06 ¯1.3308E¯06
¯3.9984E¯08 ¯4.0508E¯08 ¯4.2875E¯08 ¯1.3135E¯07 ¯1.3235E¯07 ¯1.3349E¯07  4.6852E¯08  4.8367E¯08  4.8081E¯08
 5.8372E¯10  5.9038E¯10  6.2351E¯10  1.8305E¯09  1.8452E¯09  1.8601E¯09 ¯6.8410E¯10 ¯7.0311E¯10 ¯6.9878E¯10

            Georgetown, DE                         Toms River, NJ                        Grottoes, VA
    19 PRNT ITV3
 2.2350E¯03  3.1773E¯03  3.7795E¯03  5.1442E¯03  6.0321E¯03  5.9931E¯03  7.4010E¯03  7.6804E¯03  7.2466E¯03
 2.2299E¯03  8.5622E¯04 ¯5.9349E¯04  1.7845E¯02  2.0355E¯02  2.0709E¯02  3.4471E¯03  3.3154E¯03  3.5892E¯03
 4.6307E¯03  4.7802E¯03  5.4970E¯03  1.4986E¯02  1.6236E¯02  1.6840E¯02  7.5820E¯03  8.4827E¯03  8.7035E¯03
 2.7025E¯03  3.1153E¯03  3.3351E¯03  1.1402E¯03  5.7955E¯04  2.7725E¯04  3.5265E¯03  3.4129E¯03  3.0583E¯03
¯5.8477E¯04 ¯7.6626E¯04 ¯9.9904E¯04  2.7818E¯03  3.3599E¯03  3.5086E¯03 ¯6.7216E¯04 ¯7.8722E¯04 ¯6.6250E¯04
¯3.8895E¯05 ¯1.1559E¯05  6.4638E¯05 ¯1.3953E¯03 ¯1.6252E¯03 ¯1.6693E¯03 ¯5.8808E¯05  3.3830E¯06 ¯1.9594E¯05
 2.7494E¯05  2.7066E¯05  1.3012E¯05  2.7568E¯04  3.2188E¯04  3.2951E¯04  3.1734E¯05  1.7860E¯05  2.0319E¯05
¯4.3275E¯06 ¯4.6513E¯06 ¯3.0998E¯06 ¯2.9798E¯05 ¯3.5050E¯05 ¯3.5847E¯05 ¯4.7350E¯06 ¯3.0918E¯06 ¯3.2381E¯06
 3.3369E¯07  3.7122E¯07  2.7007E¯07  1.8487E¯06  2.1895E¯06  2.2389E¯06  3.5910E¯07  2.5097E¯07  2.5493E¯07
¯1.2818E¯08 ¯1.4520E¯08 ¯1.1025E¯08 ¯6.1578E¯08 ¯7.3329E¯08 ¯7.4999E¯08 ¯1.3791E¯08 ¯1.0037E¯08 ¯1.0047E¯08
 1.9530E¯10  2.2388E¯10  1.7336E¯10  8.5205E¯10  1.0191E¯09  1.0427E¯09  2.1169E¯10  1.5809E¯10  1.5694E¯10
            Bluefield, WVA                      Baseline, Day 154                    Baseline, Day 188
    28 PRNT ITV3
 5.1199E¯04  4.5072E¯04  5.1309E¯04  2.9236E¯03  3.1934E¯03  3.7325E¯03  1.8857E¯03  2.5732E¯03  2.1568E¯03
 5.9324E¯03  5.5009E¯03  5.5701E¯03  1.7314E¯02  1.8682E¯02  1.8661E¯02  1.4447E¯02 ¯2.4019E¯02  1.5600E¯02
 1.5603E¯02  1.4421E¯02  1.3521E¯02  2.2899E¯02  2.2821E¯02  1.9313E¯02  2.6932E¯02  6.9425E¯02  2.6834E¯02
¯6.3170E¯03 ¯5.8719E¯03 ¯5.1186E¯03 ¯1.0825E¯02 ¯1.1025E¯02 ¯7.5585E¯03 ¯1.1118E¯02 ¯5.3514E¯02 ¯1.1823E¯02
 1.3432E¯03  1.2492E¯03  1.0279E¯03  1.0422E¯02  1.1269E¯02  9.8098E¯03  1.1531E¯02  3.0041E¯02  1.2207E¯02
 6.5501E¯05  7.8411E¯05  1.0542E¯04 ¯3.8718E¯03 ¯4.2427E¯03 ¯3.9093E¯03 ¯4.5229E¯03 ¯8.7587E¯03 ¯4.7988E¯03
¯7.0599E¯05 ¯7.1157E¯05 ¯7.1374E¯05  7.2141E¯04  7.9287E¯04  7.4698E¯04  8.6530E¯04  1.4306E¯03  9.1821E¯04
 1.1494E¯05  1.1404E¯05  1.1106E¯05 ¯7.6665E¯05 ¯8.4124E¯05 ¯8.0188E¯05 ¯9.2756E¯05 ¯1.3823E¯04 ¯9.8513E¯05
¯8.7138E¯07 ¯8.5823E¯07 ¯8.2612E¯07  4.7160E¯06  5.1555E¯06  4.9493E¯06  5.6993E¯06  7.8623E¯06  6.0568E¯06
 3.2651E¯08  3.2004E¯08  3.0608E¯08 ¯1.5607E¯07 ¯1.6985E¯07 ¯1.6382E¯07 ¯1.8748E¯07 ¯2.4334E¯07 ¯1.9936E¯07
¯4.8848E¯10 ¯4.7712E¯10 ¯4.5447E¯10  2.1477E¯09  2.3269E¯09  2.2515E¯09  2.5602E¯09  3.1609E¯09  2.7235E¯09
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Appendix E

CARRIER MODULATIONS AND PULSE ENVELOPES

This appendix presents graphical representations of the measured pulses. The plots are constructed from values of voltage evaluated from the polynomials of Tables D-5 through D-8. Figures E-1 through E-36 present the sine and cosine modulations for all the sites and all data segments. Figures E-37 through E-72 present the corresponding pulse envelopes. The voltages plotted on these figures are those associated with pulses that have the same energy. Tables E-1 and E-2 present the times of the zero crossings in the pulses relative to the reference time of the voltage samples. The vertical groups of three rows are for the three data segments. The labels C1, C2 ... C0 on the left denote the location of the instrumented van during data recordings (see Table E-3).

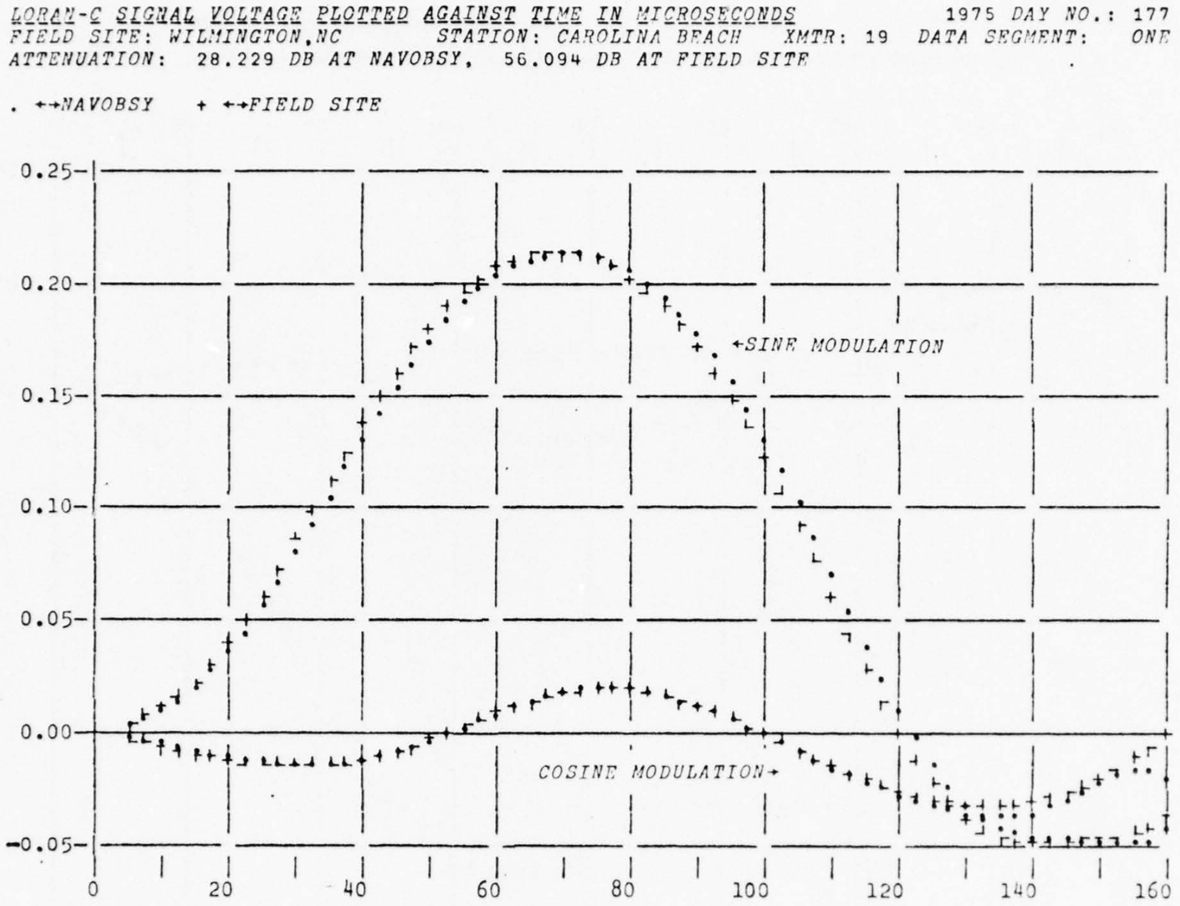


Fig. E-1 Sine and Cosine Modulations Observed Simultaneously at Wilmington, NC, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 *DAY NO.:* 177
FIELD SITE: WILMINGTON,NC *STATION: CAROLINA BEACH* *XMTR:* 19 *DATA SEGMENT: TWO*
ATTENUATION: 28.207 *DB AT NAVOBSY,* 56.089 *DB AT FIELD SITE*

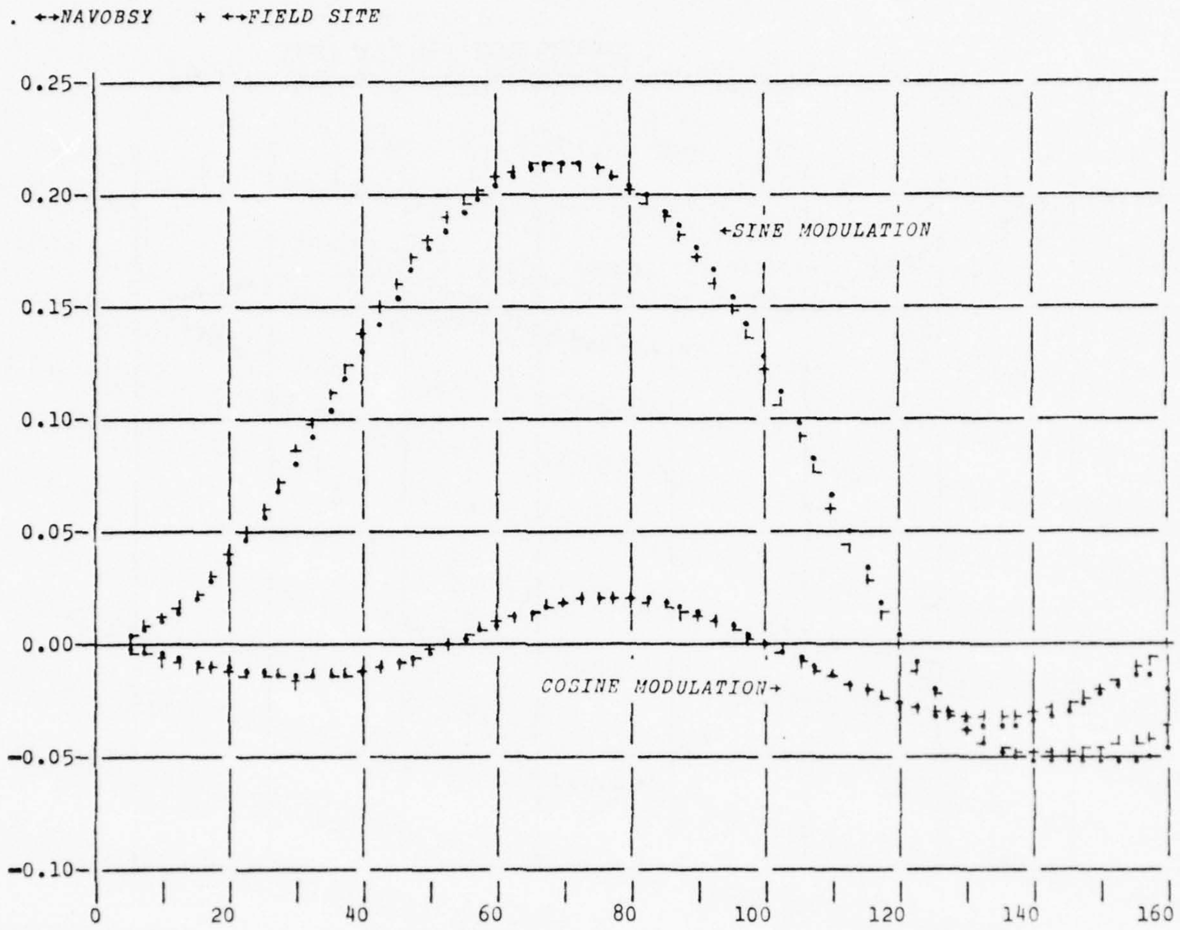


Fig. E-2 Sine and Cosine Modulations Observed Simultaneously at Wilmington, NC, and NAVOBSY; Data Segment 2

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 177
FIELD SITE: WILMINGTON,NC STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: THREE
ATTENUATION: 28.133 DB AT NAVOBSY, 56.018 DB AT FIELD SITE

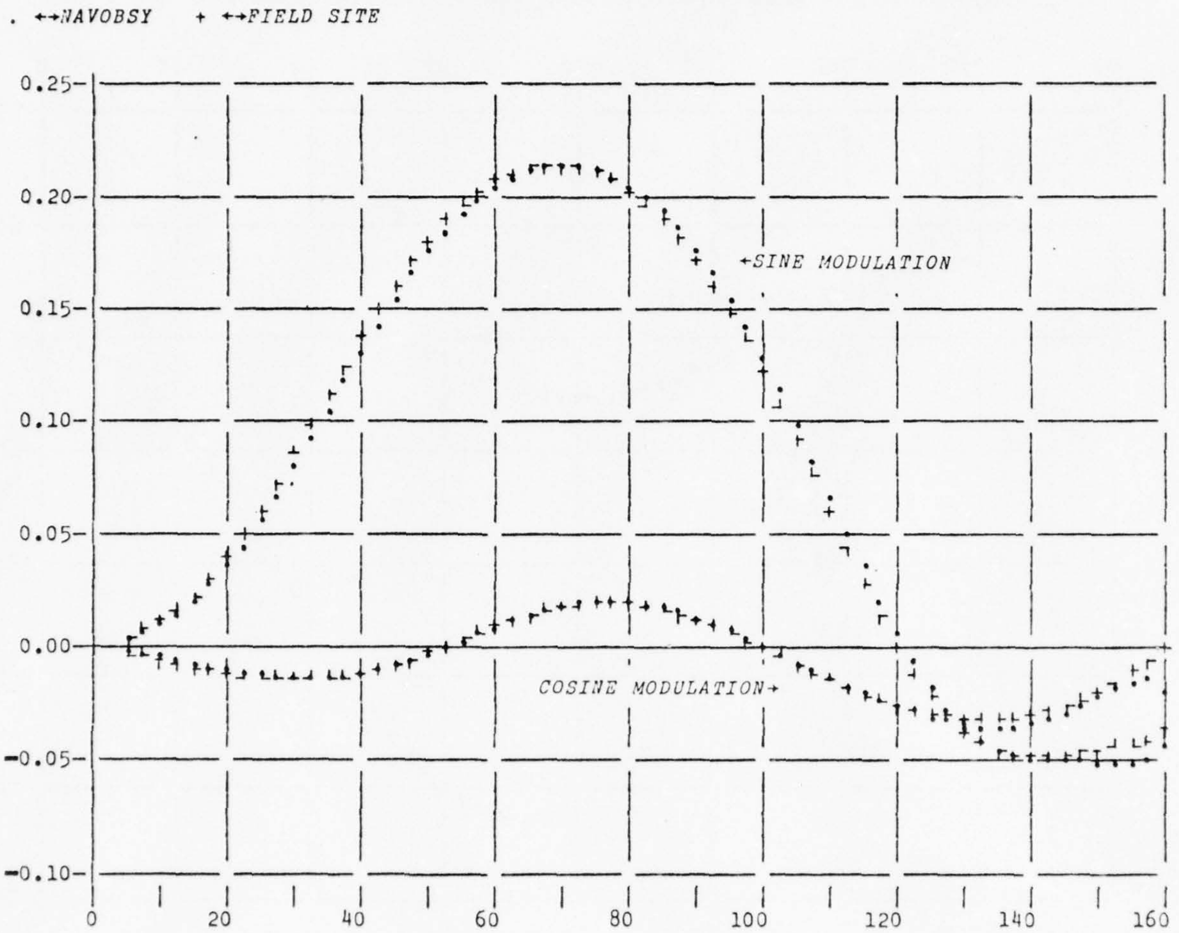


Fig. E-3 Sine and Cosine Modulations Observed Simultaneously at Wilmington, NC, and NAVOBSY; Data Segment 3

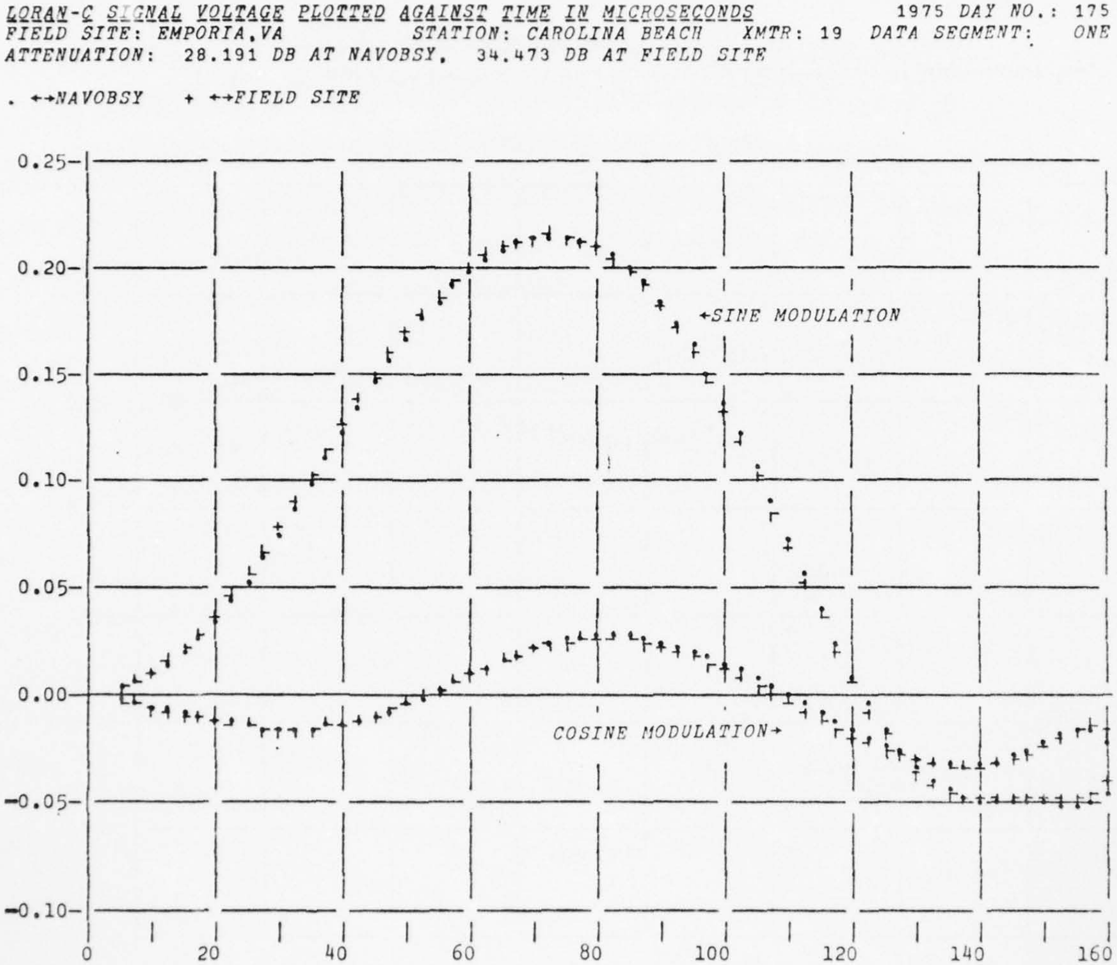
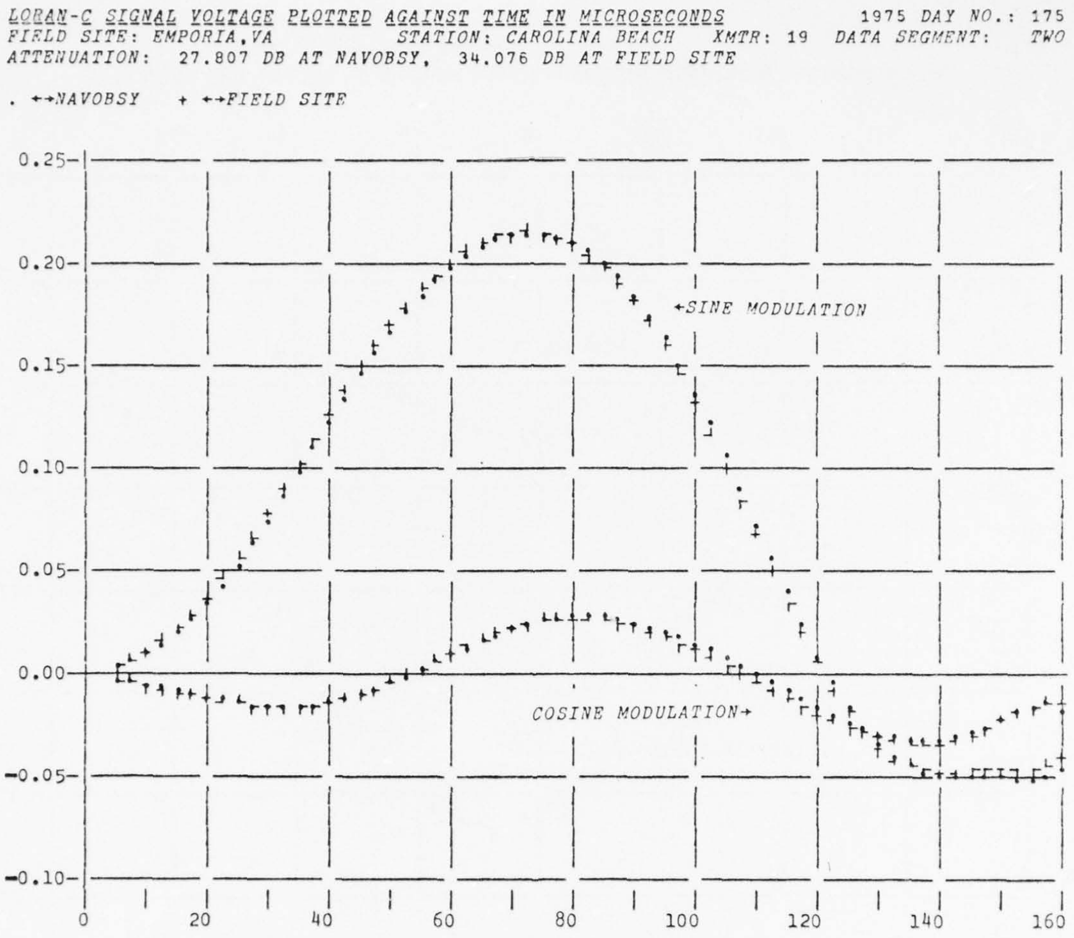
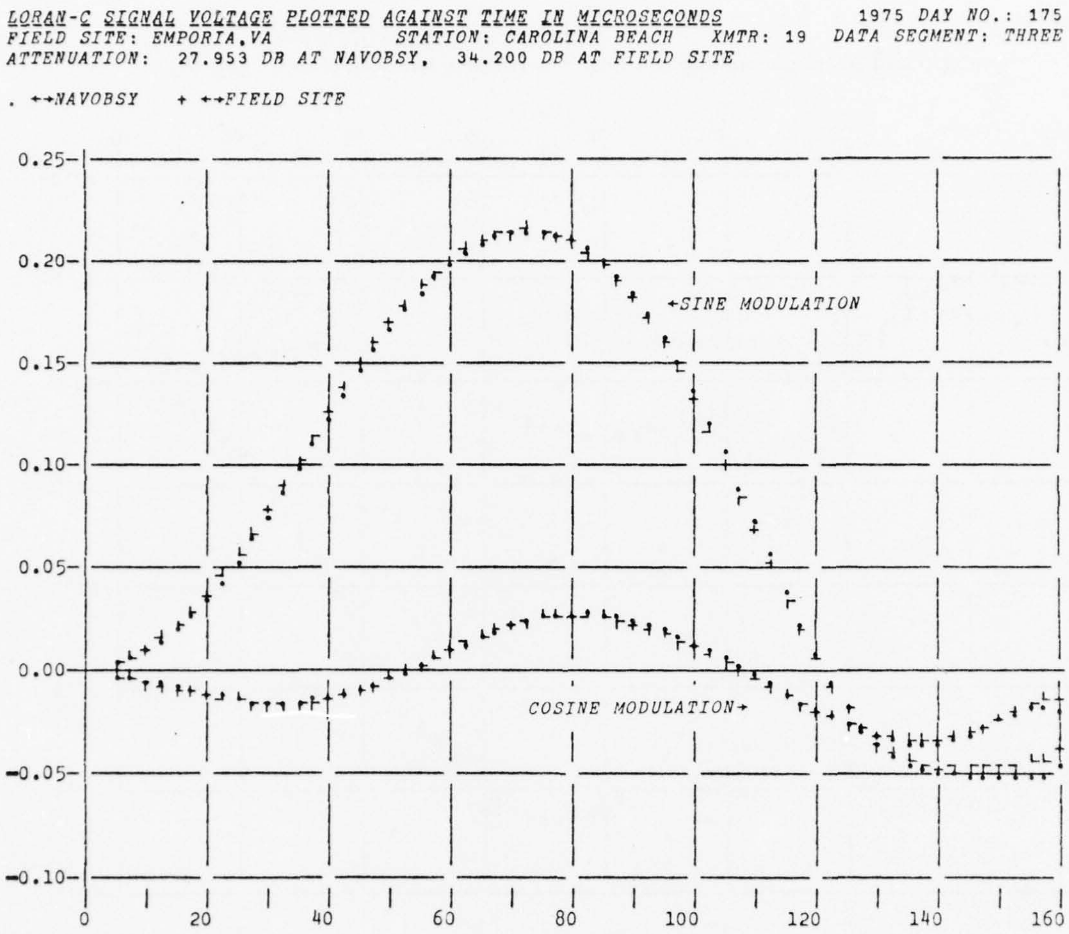


Fig. E-4 Sine and Cosine Modulations Observed Simultaneously at Emporia, VA, and NAVOBSY; Data Segment 1



LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 175
FIELD SITE: EMPORIA,VA STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 27.807 DB AT NAVOBSY, 34.076 DB AT FIELD SITE

Fig. E-5 Sine and Cosine Modulations Observed Simultaneously at Emporia, VA, and NAVOBSY; Data Segment 2



LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 175
FIELD SITE: EMPORIA,VA STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: THREE
ATTENUATION: 27.953 DB AT NAVOBSY, 34.200 DB AT FIELD SITE

Fig. E-6 Sine and Cosine Modulations Observed Simultaneously at Emporia, VA, and NAVOBSY; Data Segment 3

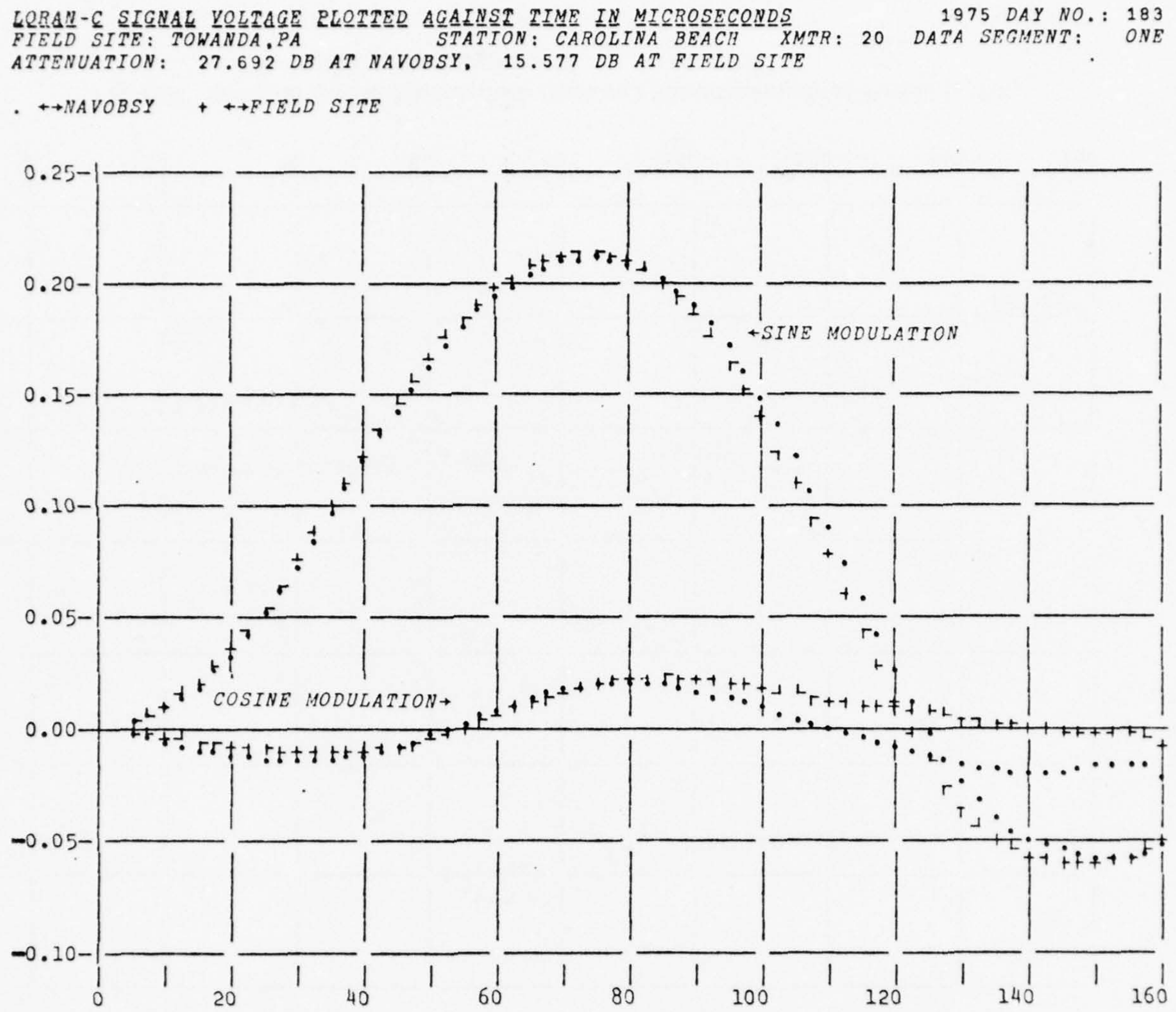


Fig. E-7 Sine and Cosine Modulations Observed Simultaneously at Towanda, PA, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 183
FIELD SITE: TOWANDA,PA STATION: CAROLINA BEACH XMTR: 20 DATA SEGMENT: TWO
ATTENUATION: 27.765 DB AT NAVOBSY, 15.763 DB AT FIELD SITE

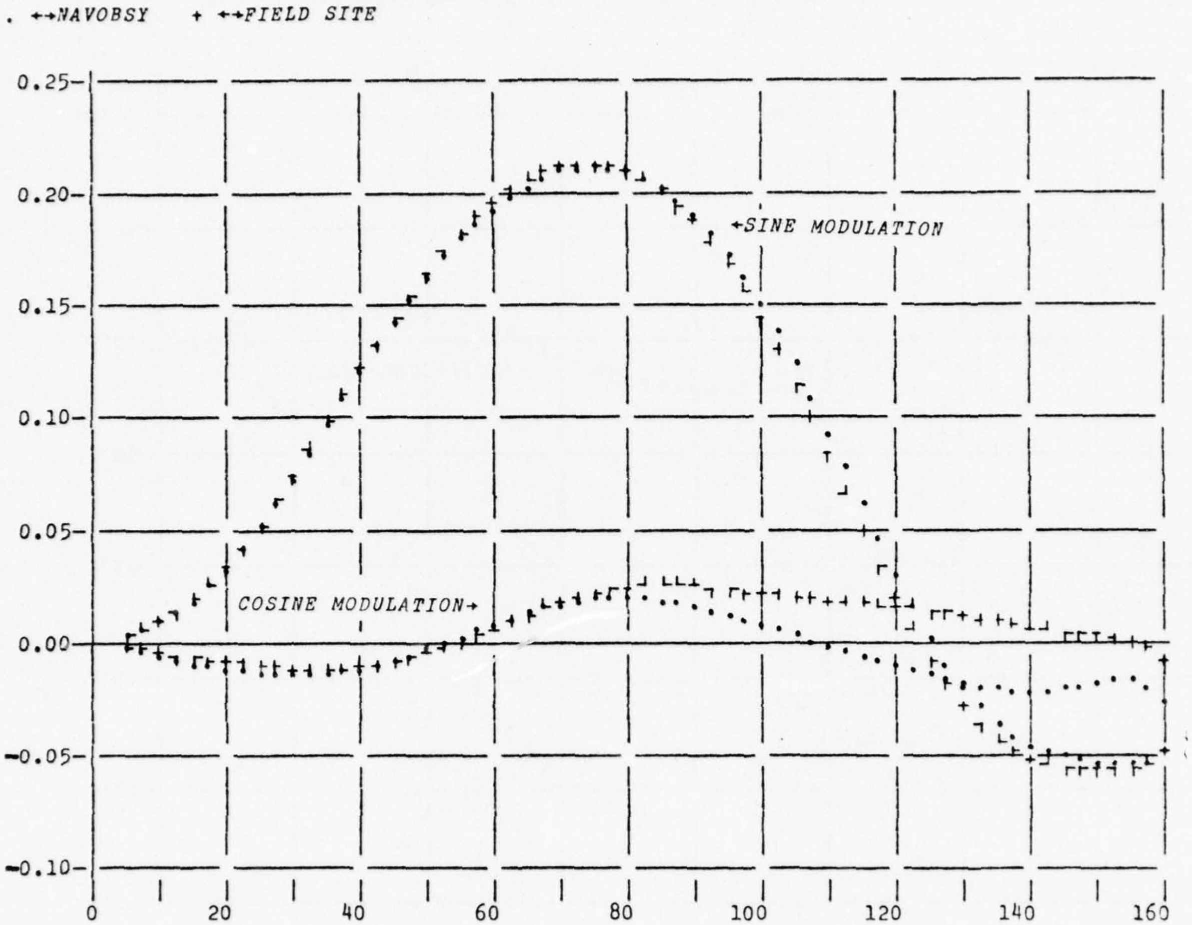


Fig. E-8 Sine and Cosine Modulations Observed Simultaneously at Towanda, PA, and NAVOBSY; Data Segment 2

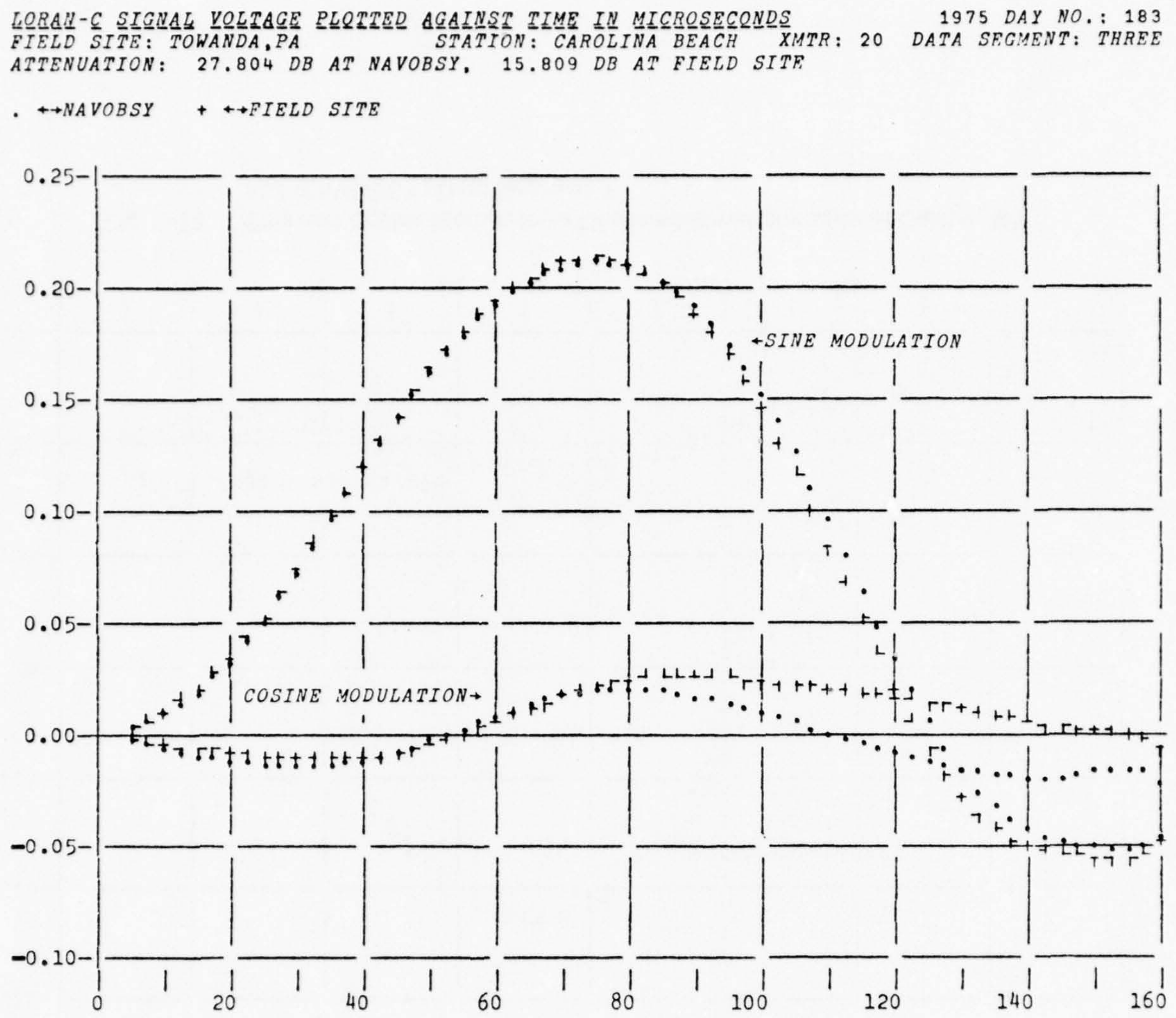
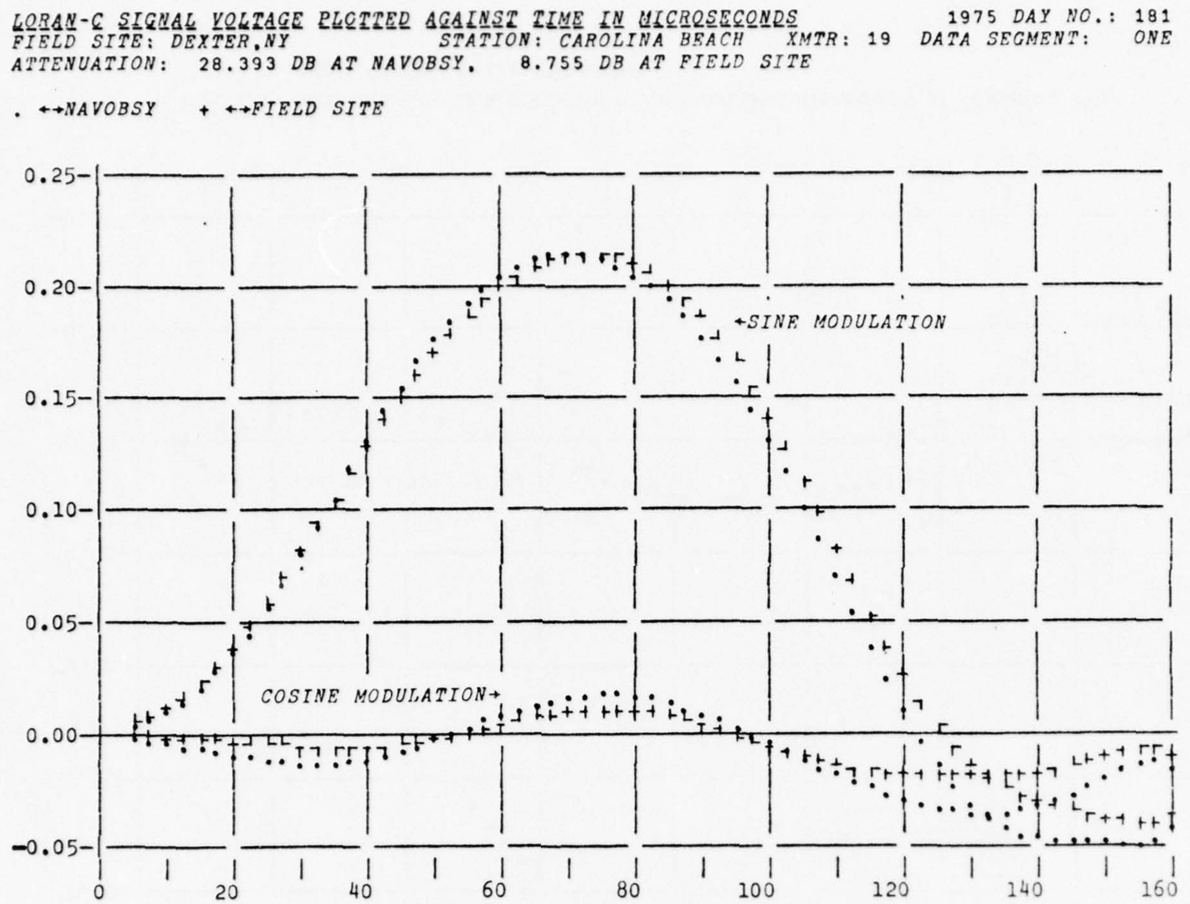


Fig. E-9 Sine and Cosine Modulations Observed Simultaneously at Towanda, PA, and NAVOBSY; Data Segment 3


LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 181
FIELD SITE: DEXTER,NY STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: ONE
ATTENUATION: 28.393 DB AT NAVOBSY, 8.755 DB AT FIELD SITE

. ←→NAVOBSY + ←→FIELD SITE

Fig. E-10 Sine and Cosine Modulations Observed Simultaneously at Dexter, NY, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 181
FIELD SITE: DEXTER,NY STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 28.320 DB AT NAVOBSY, 8.698 DB AT FIELD SITE

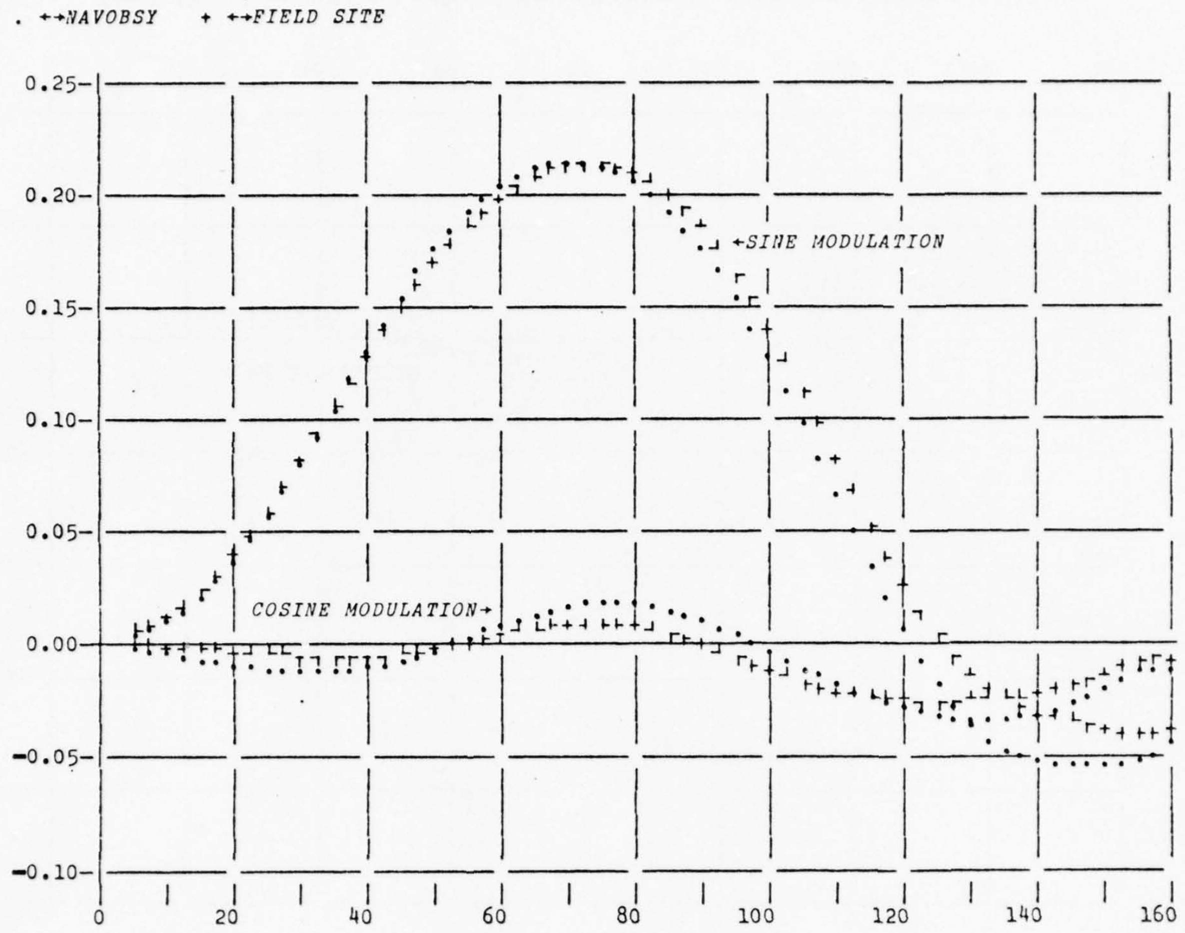
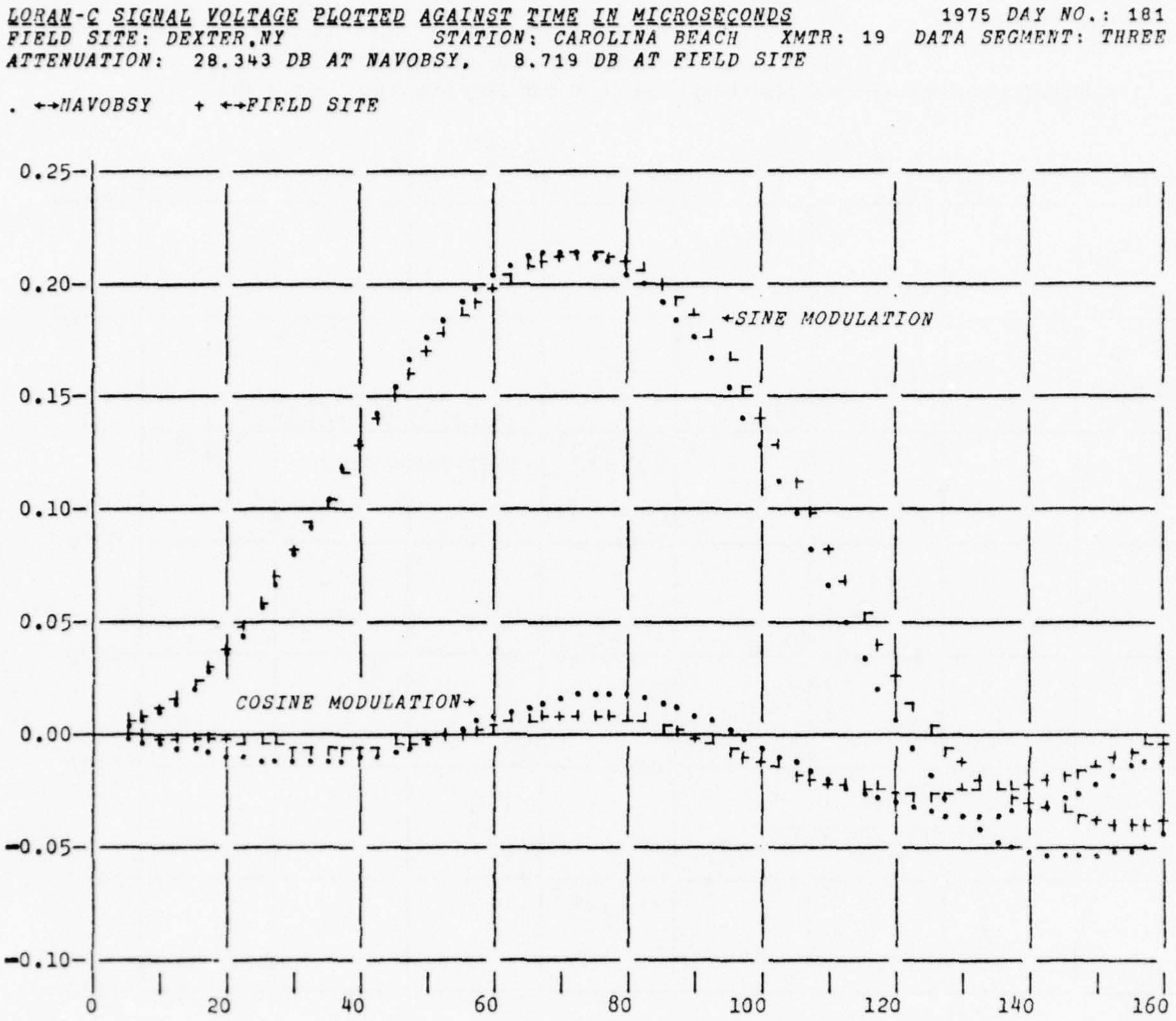


Fig. E-11 Sine and Cosine Modulations Observed Simultaneously at Dexter, NY, and NAVOBSY; Data Segment 2



LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 181
FIELD SITE: DEXTER,NY STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: THREE
ATTENUATION: 28.343 DB AT NAVOBSY, 8.719 DB AT FIELD SITE

Fig. E-12 Sine and Cosine Modulations Observed Simultaneously at Dexter, NY, and NAVOBSY; Data Segment 3

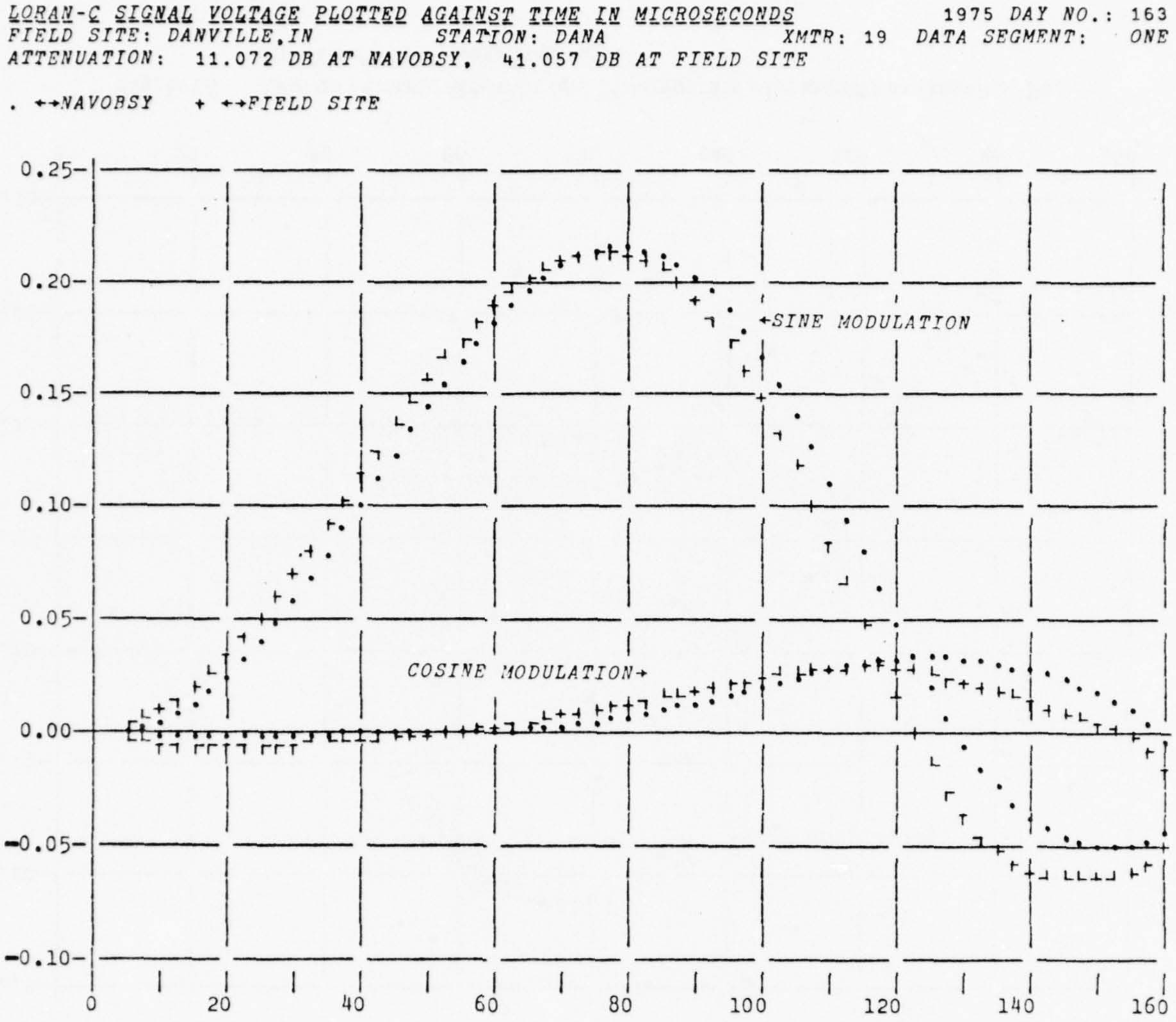


Fig. E-13 Sine and Cosine Modulations Observed Simultaneously at Danville, IN, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 163
FIELD SITE: DANVILLE,IN STATION: DANA XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 11.089 DB AT NAVOBSY, 41.082 DB AT FIELD SITE

. ←→NAVOBSY + ←→FIELD SITE

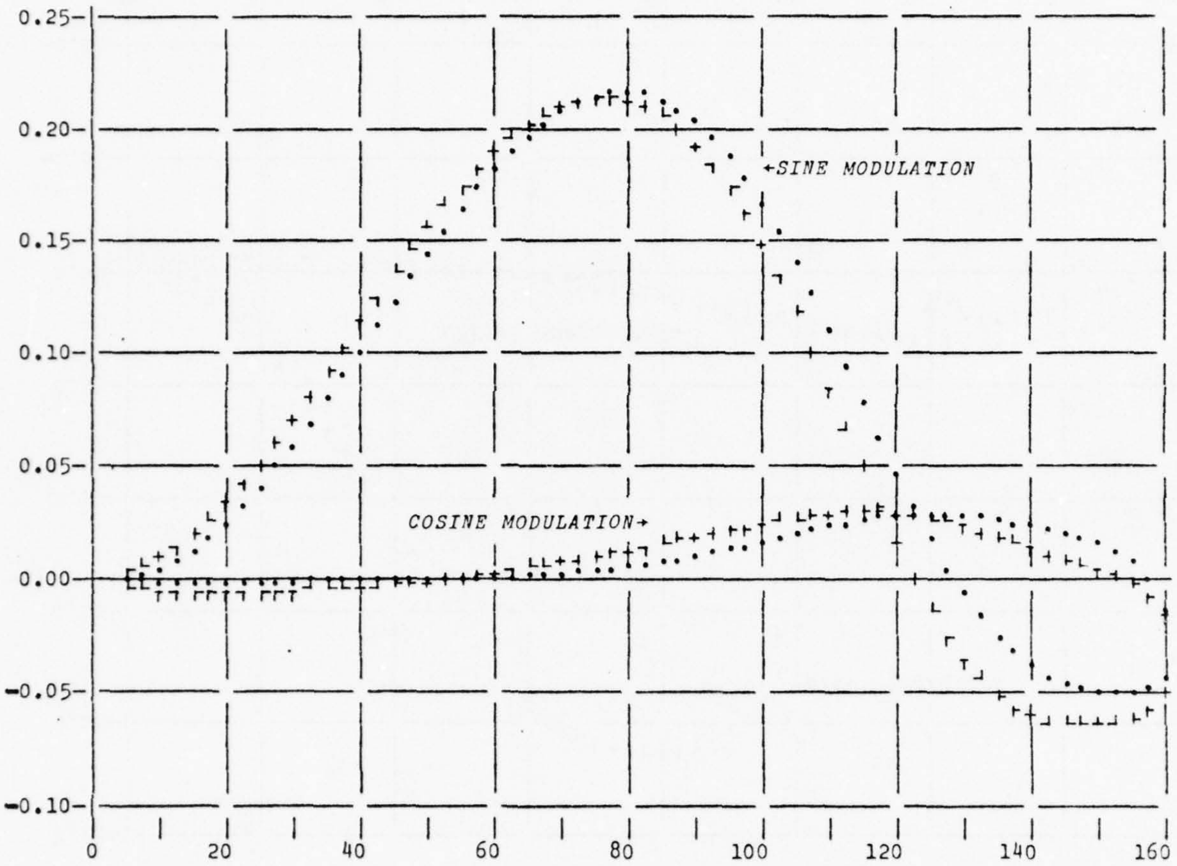


Fig. E-14 Sine and Cosine Modulations Observed Simultaneously at Danville, IN, and NAVOBSY; Data Segment 2

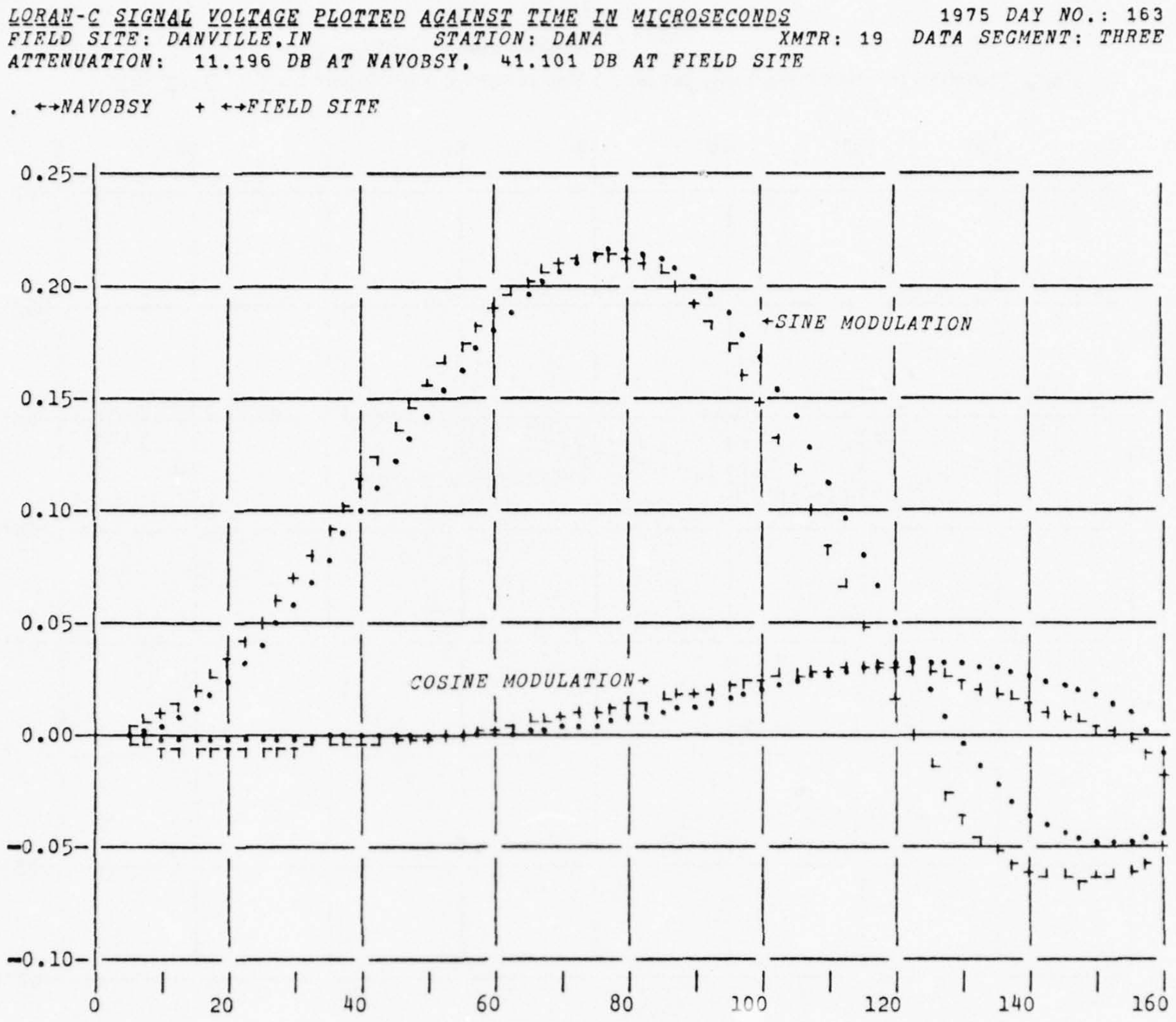


Fig. E-15 Sine and Cosine Modulations Observed Simultaneously at Danville, IN, and NAVOBSY; Data Segment 3

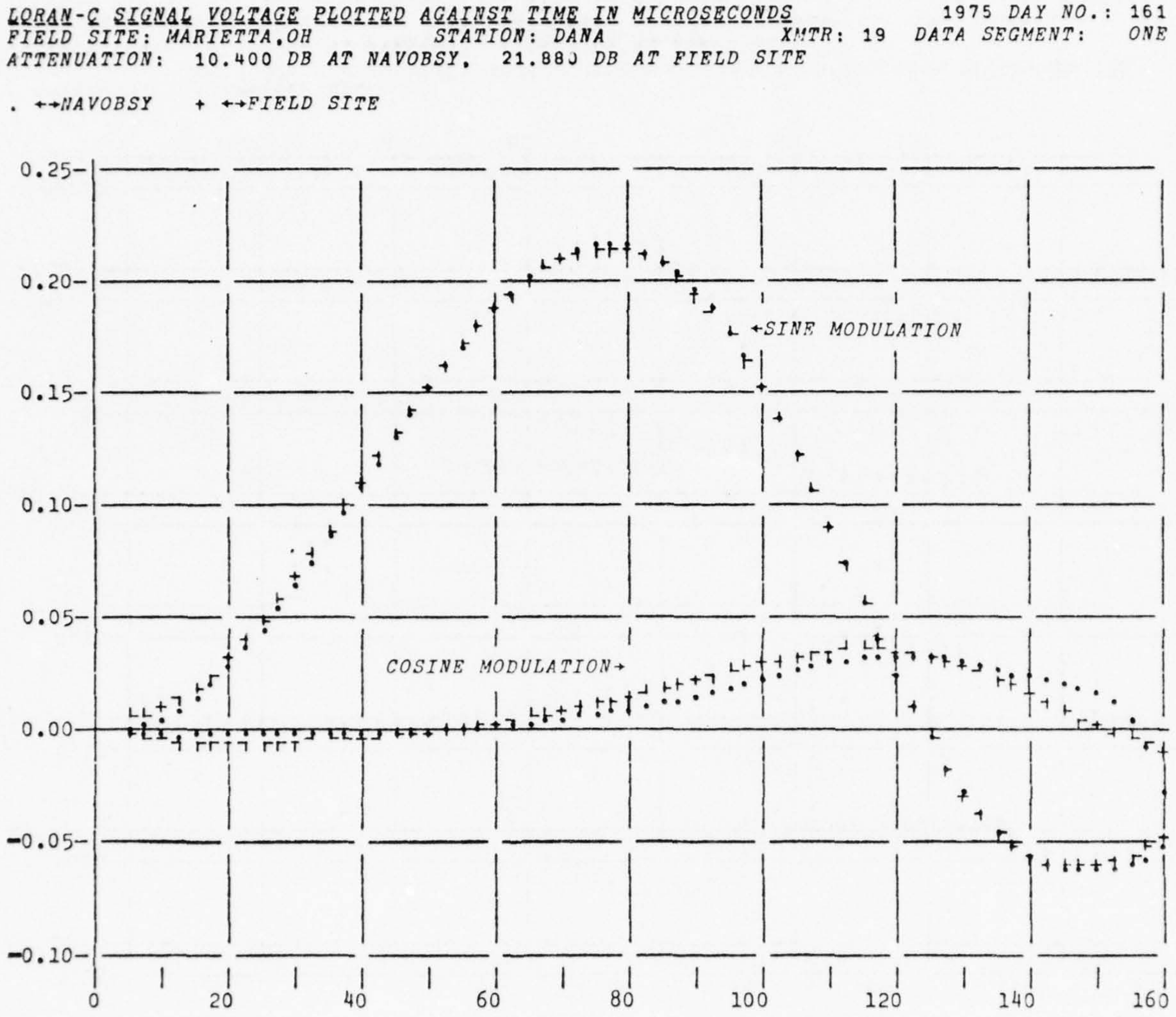


Fig. E-16 Sine and Cosine Modulations Observed Simultaneously at Marietta, OH, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 161
FIELD SITE: MARIETTA,OH STATION: DANA XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 10.381 DB AT NAVOBSY, 21.897 DB AT FIELD SITE

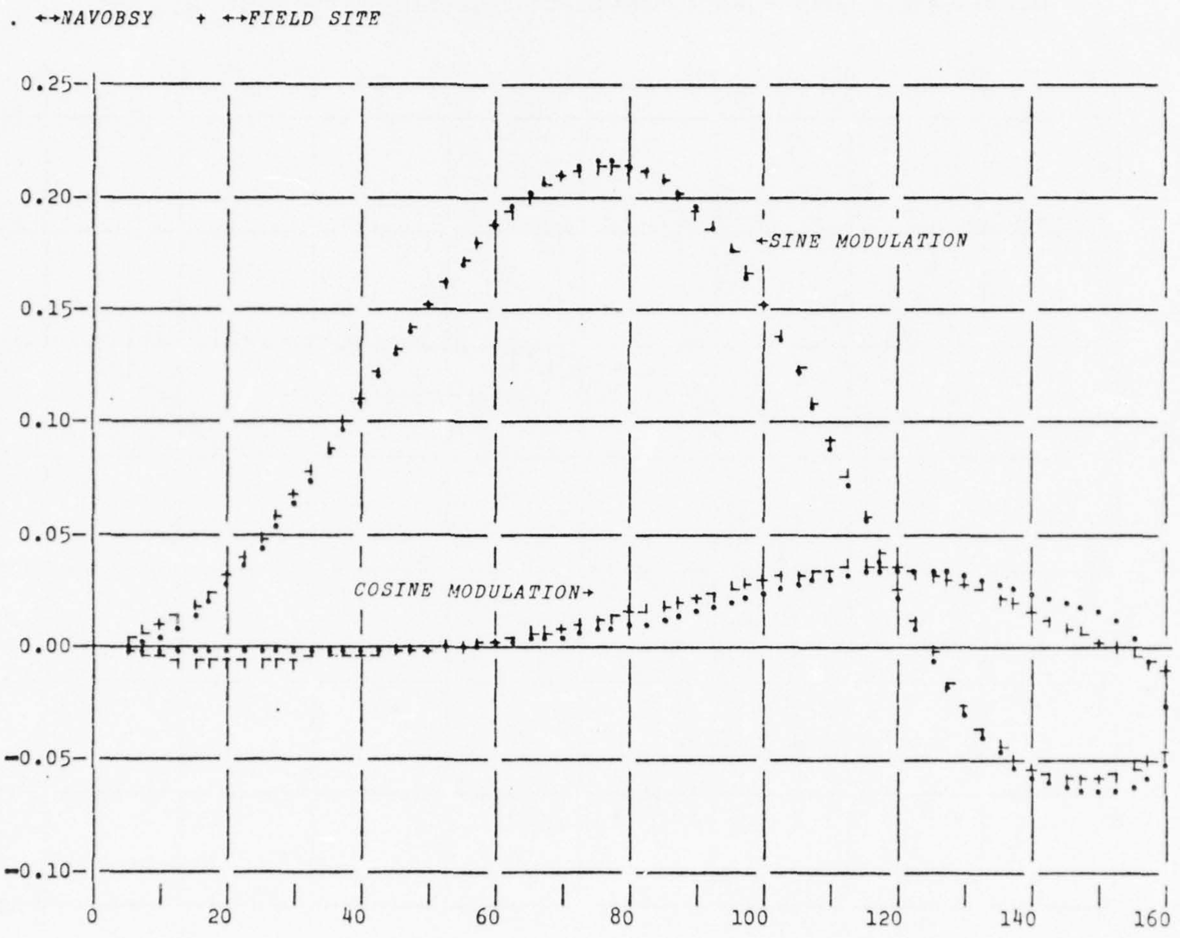


Fig. E-17 Sine and Cosine Modulations Observed Simultaneously at Marietta, OH, and NAVOBSY; Data Segment 2

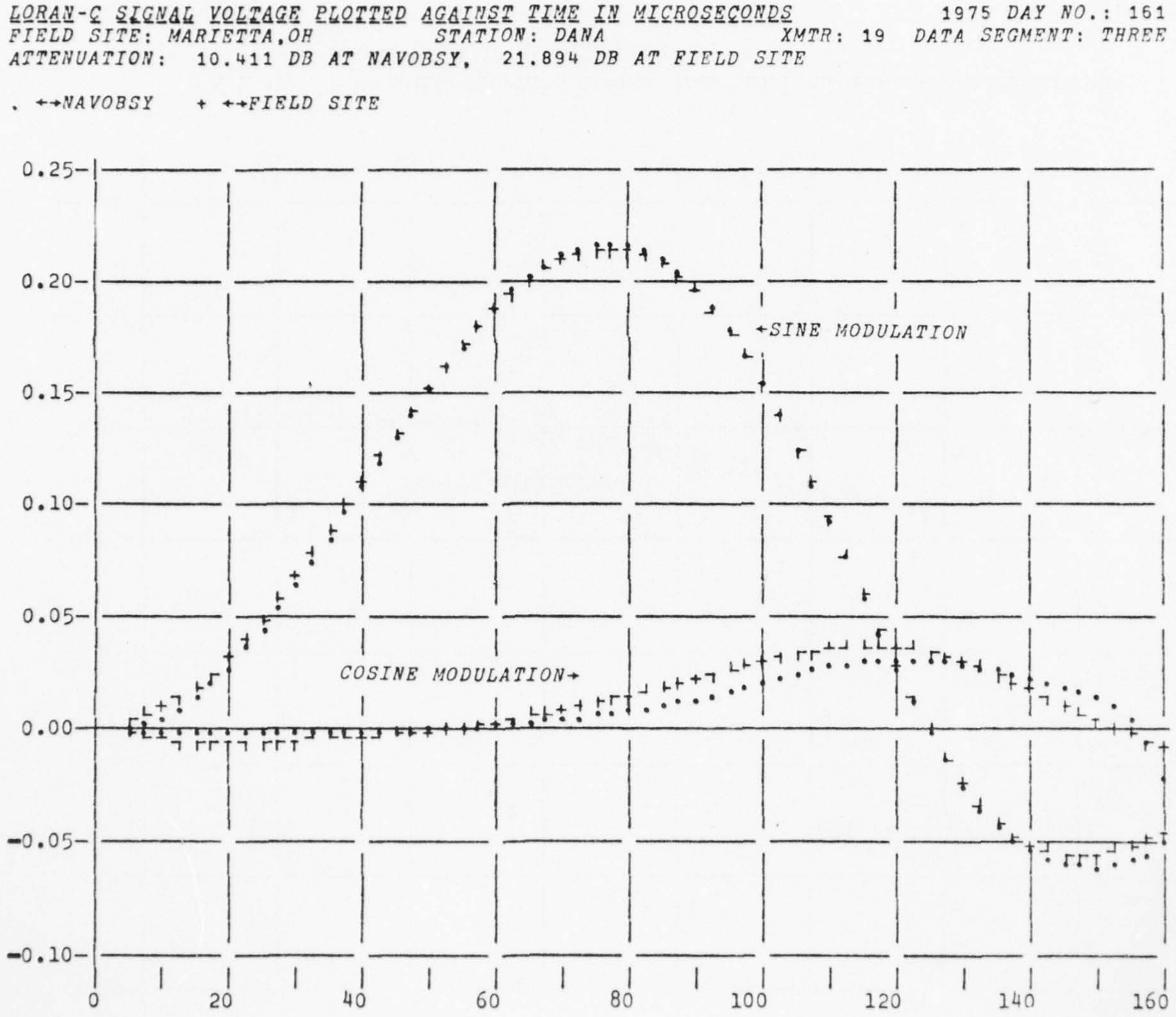


Fig. E-18 Sine and Cosine Modulations Observed Simultaneously at Marietta, OH, and NAVOBSY; Data Segment 3

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 *DAY NO.*: 156
FIELD SITE: GEORGETOWN,DE *STATION: DANA* *XMTR*: 19 *DATA SEGMENT: ONE*
ATTENUATION: 10.414 *DB AT NAVOBSY*, 7.474 *DB AT FIELD SITE*

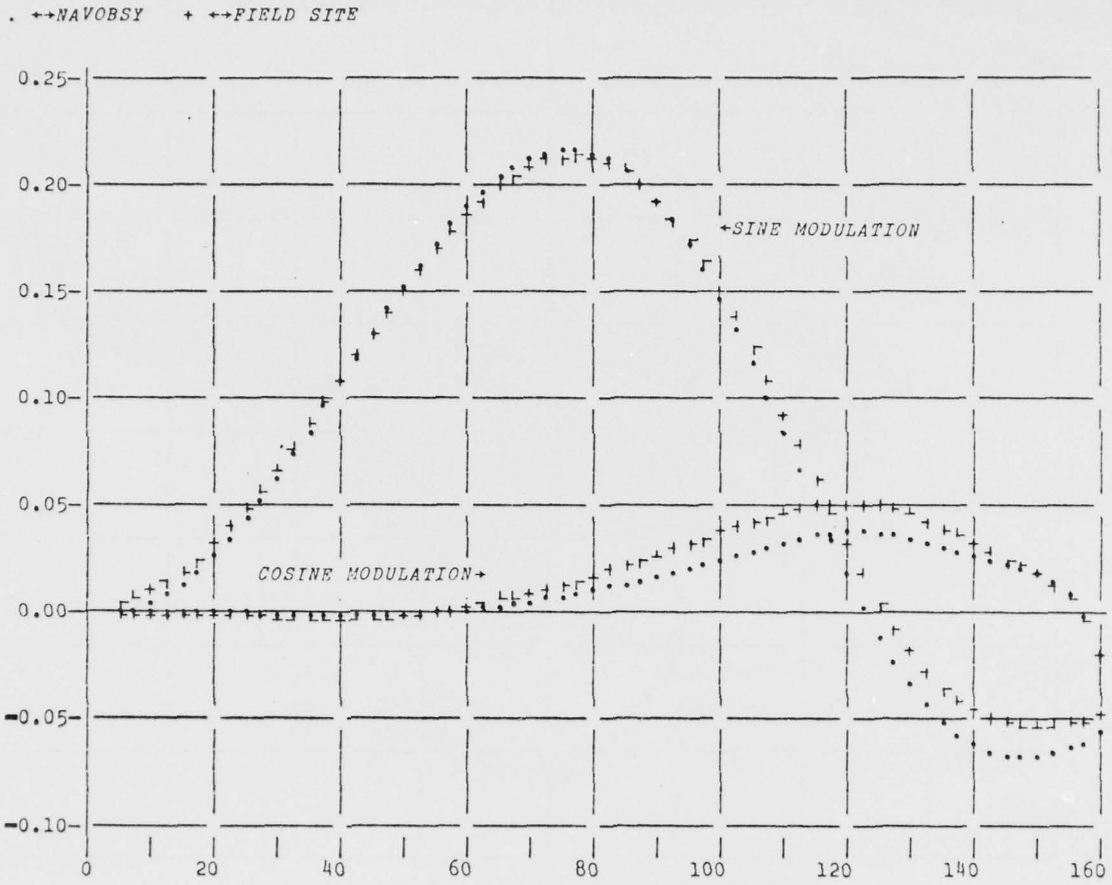


Fig. E-19 Sine and Cosine Modulations Observed Simultaneously at Georgetown, DE, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 156
FIELD SITE: GEORGETOWN,DE STATION: DANA XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 10.810 DB AT NAVOBSY, 7.723 DB AT FIELD SITE

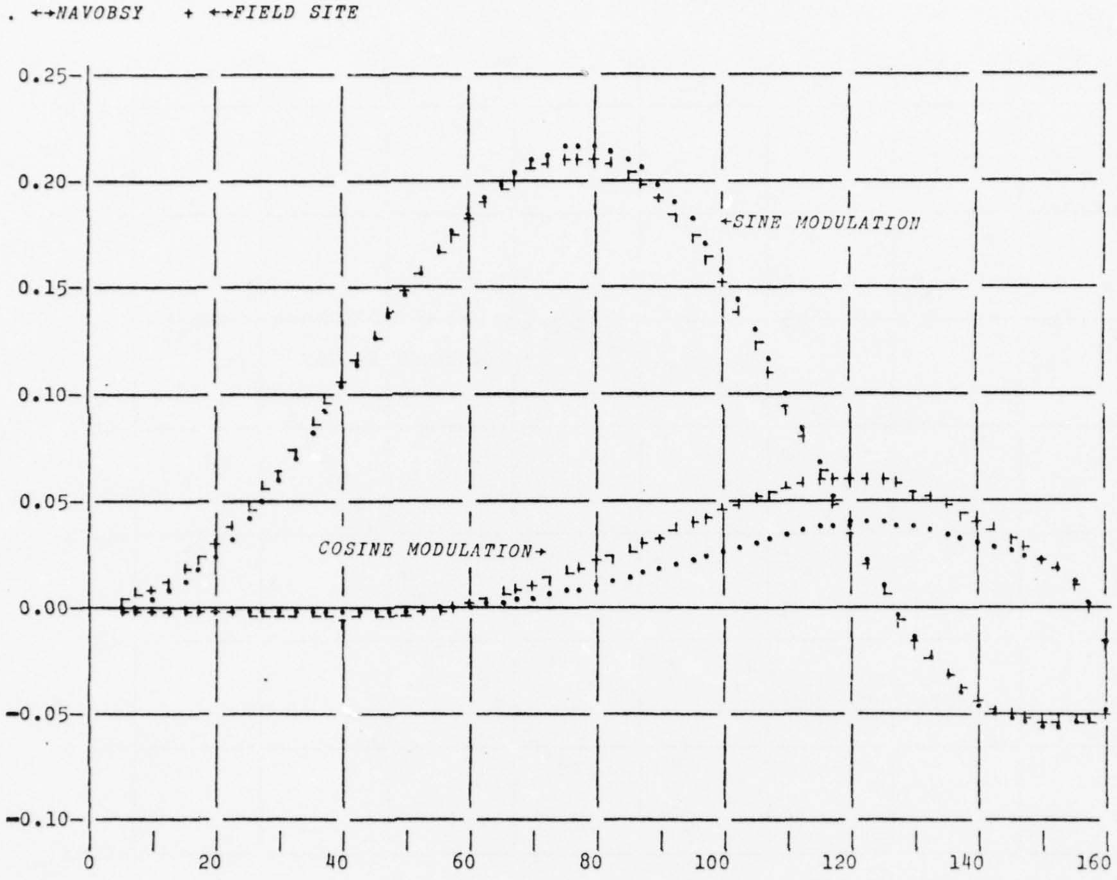
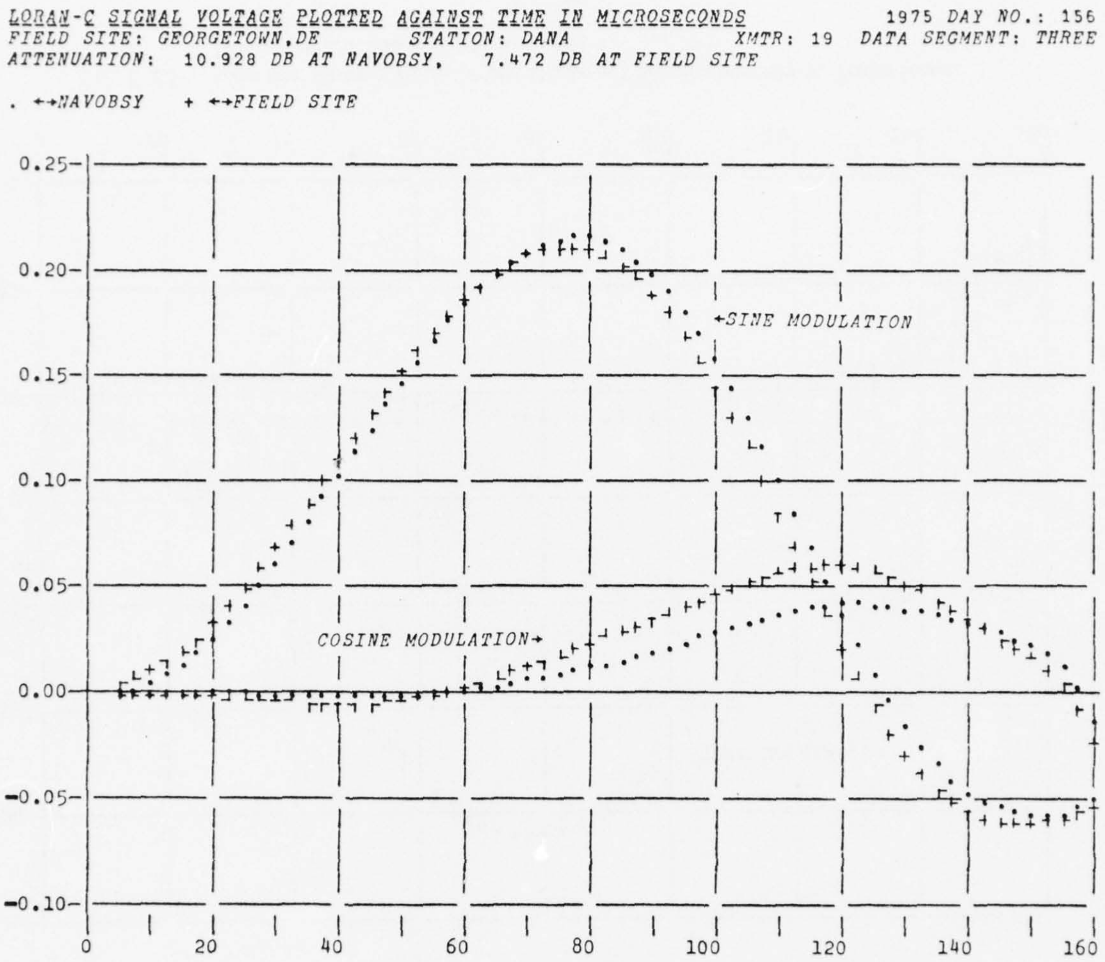


Fig. E-20 Sine and Cosine Modulations Observed Simultaneously at Georgetown, DE, and NAVOBSY; Data Segment 2



LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 156
FIELD SITE: GEORGETOWN,DE STATION: DANA XMTR: 19 DATA SEGMENT: THREE
ATTENUATION: 10.928 DB AT NAVOBSY, 7.472 DB AT FIELD SITE

Fig. E-21 Sine and Cosine Modulations Observed Simultaneously at Georgetown, DE, and NAVOBSY; Data Segment 3

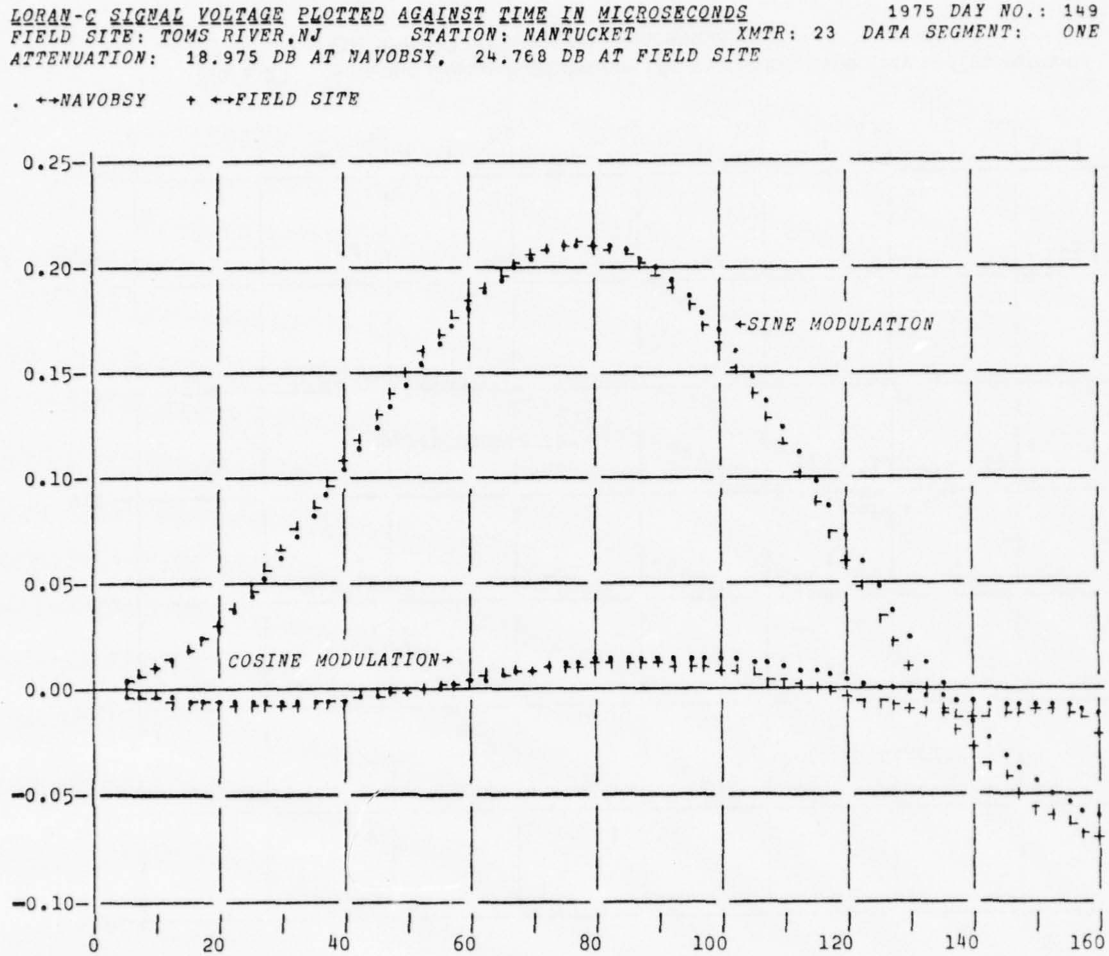


Fig. E-22 Sine and Cosine Modulations Observed Simultaneously at Toms River, NJ, and NAVOBSY; Data Segment 1

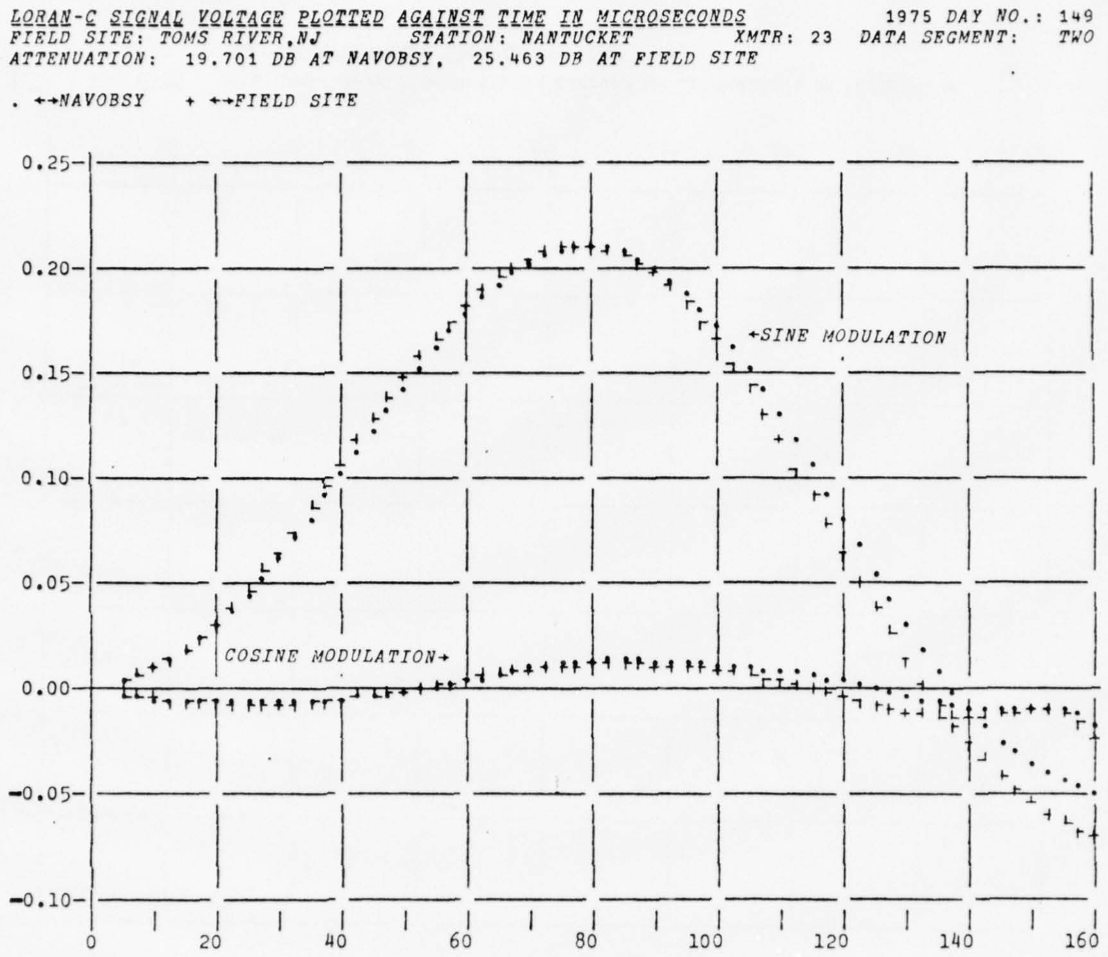


Fig. E-23 Sine and Cosine Modulations Observed Simultaneously at Toms River, NJ, and NAVOBSY; Data Segment 2

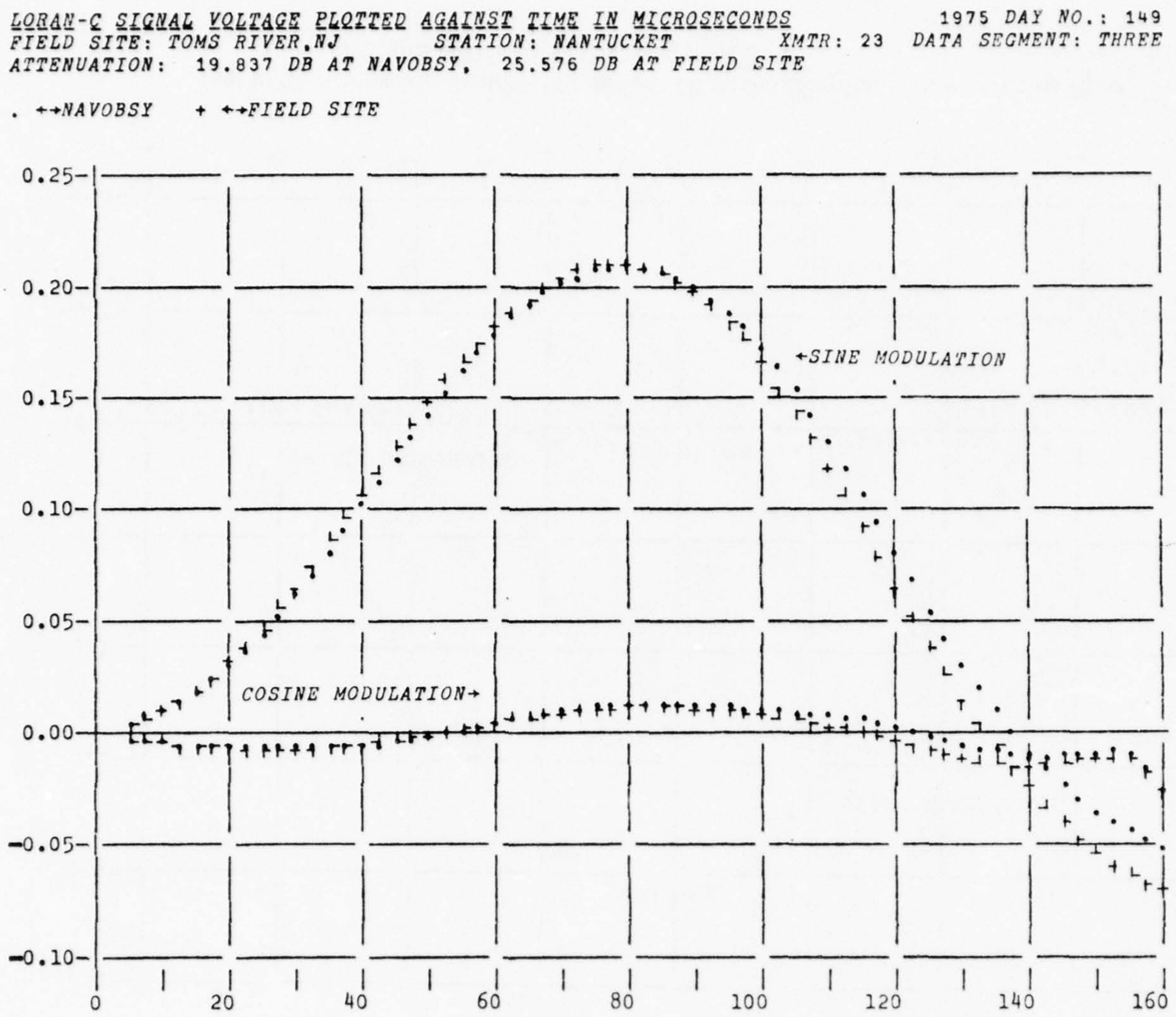


Fig. E-24 Sine and Cosine Modulations Observed Simultaneously at Toms River, NJ, and NAVOBSY; Data Segment 3

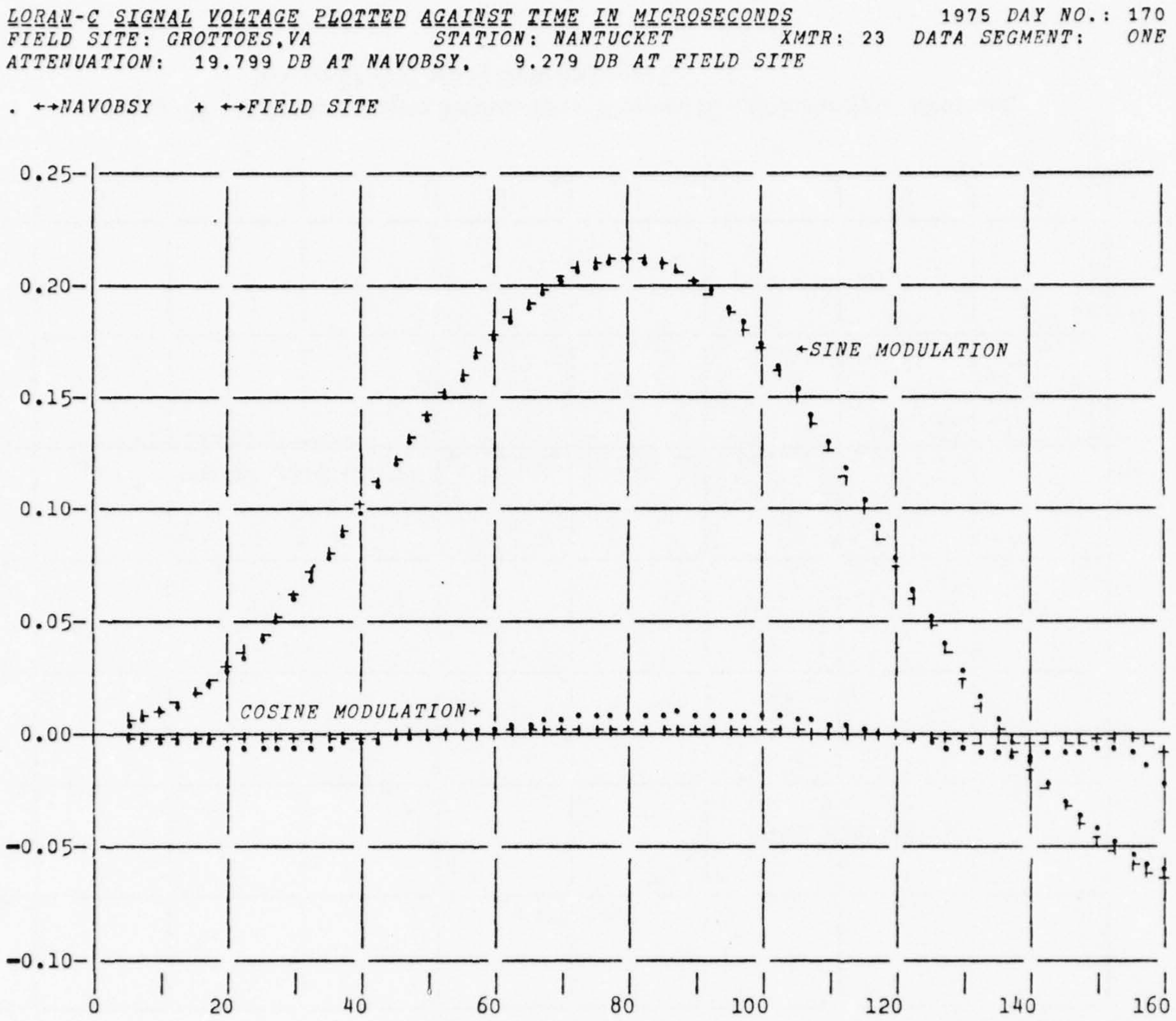
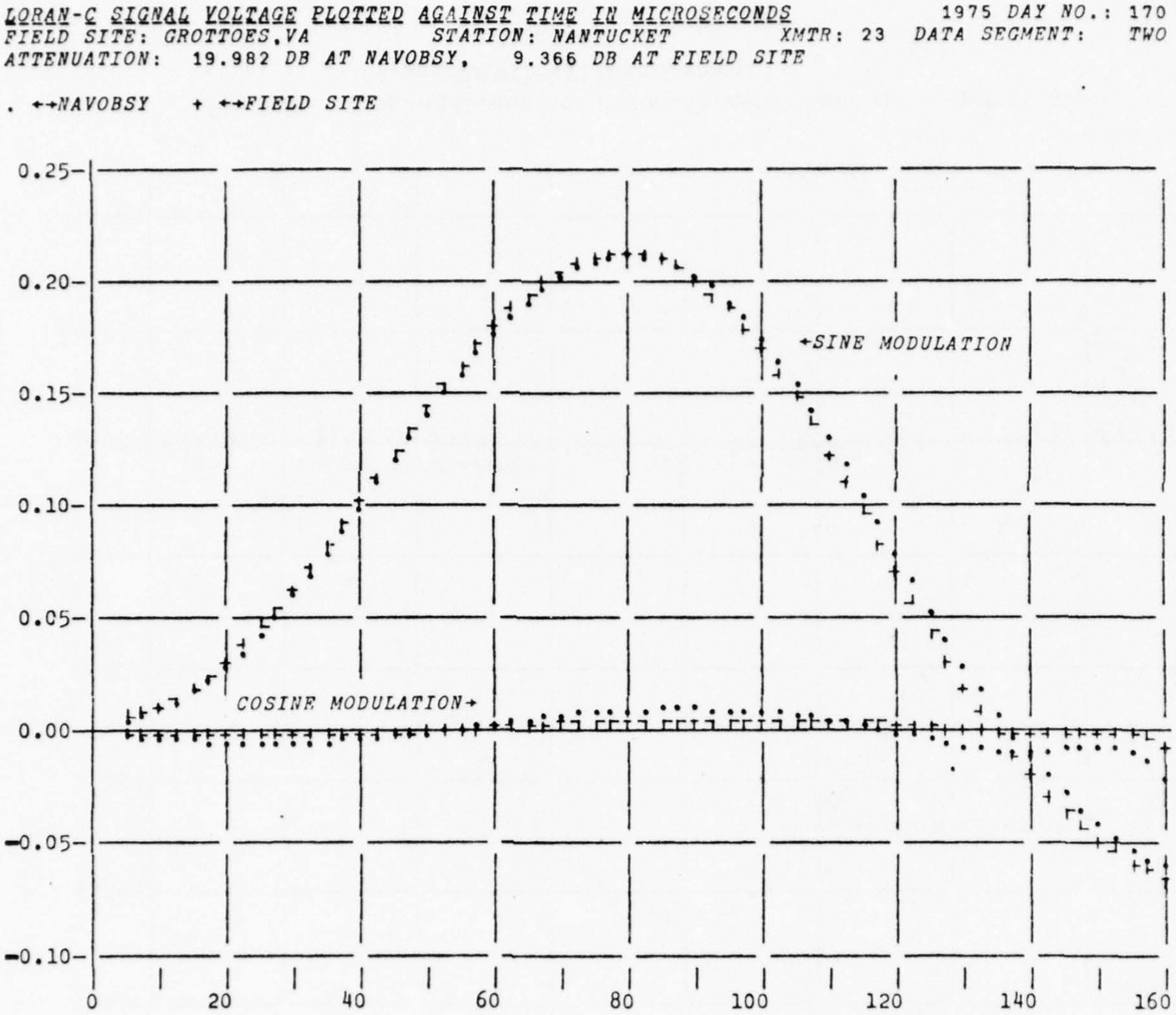


Fig. E-25 Sine and Cosine Modulations Observed Simultaneously at Grottoes, VA, and NAVOBSY; Data Segment 1



LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 170
FIELD SITE: GROTTOES,VA STATION: NANTUCKET XMTR: 23 DATA SEGMENT: TWO
ATTENUATION: 19.982 DB AT NAVOBSY, 9.366 DB AT FIELD SITE

Fig. E-26 Sine and Cosine Modulations Observed Simultaneously at Grottoes, VA, and NAVOBSY; Data Segment 2

<u>LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS</u> 1975 *DAY NO.*: 170
FIELD SITE: GROTTOES,VA STATION: NANTUCKET XMTR: 23 *DATA SEGMENT: THREE*
ATTENUATION: 19.958 *DB AT NAVOBSY,* 9.271 *DB AT FIELD SITE*

. ←→*NAVOBSY* + ←→*FIELD SITE*

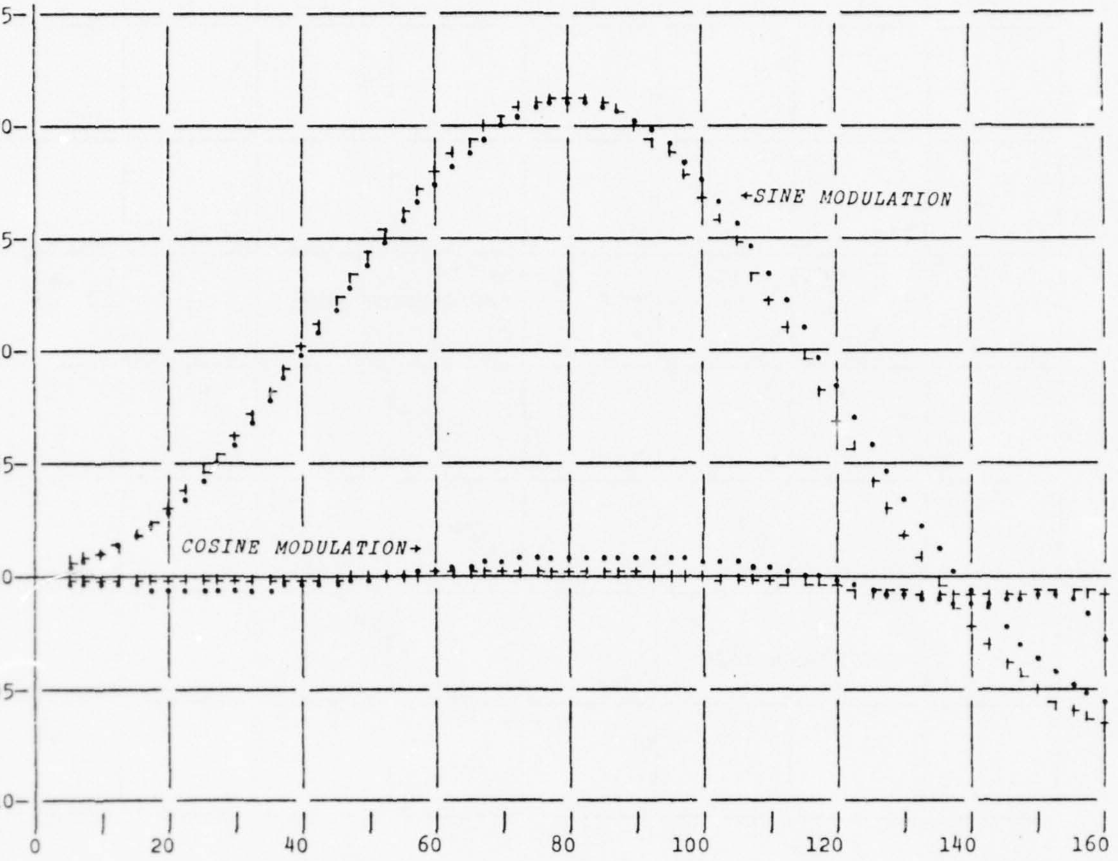


Fig. E-27 Sine and Cosine Modulations Observed Simultaneously at Grottoes, VA, and NAVOBSY; Data Segment 3

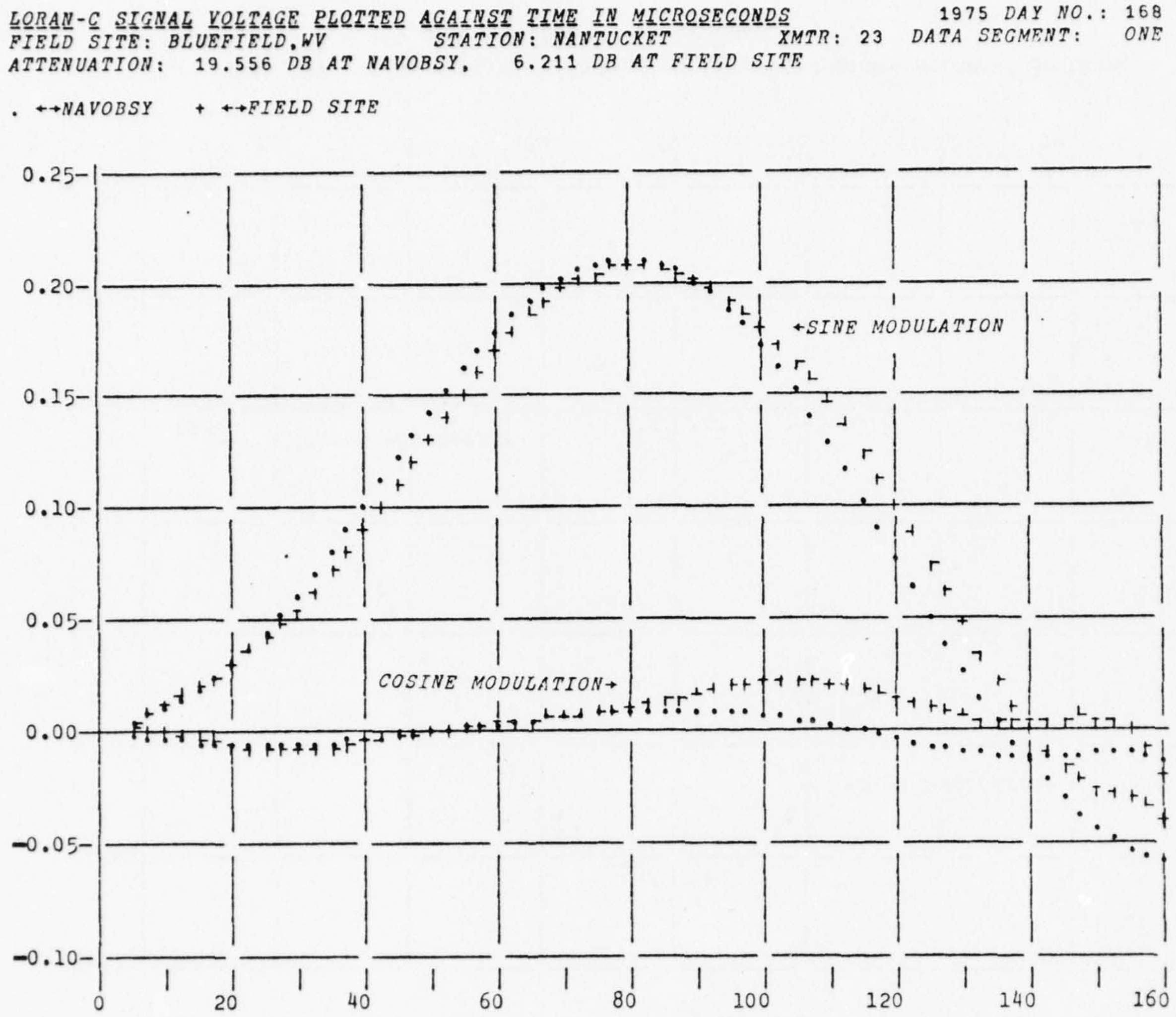


Fig. E-28 Sine and Cosine Modulations Observed Simultaneously at Bluefield, WV, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS   1975 DAY NO.: 168
FIELD SITE: BLUEFIELD,WV   STATION: NANTUCKET   XMTR: 23   DATA SEGMENT: TWO
ATTENUATION: 19.488 DB AT NAVOBSY, 6.112 DB AT FIELD SITE

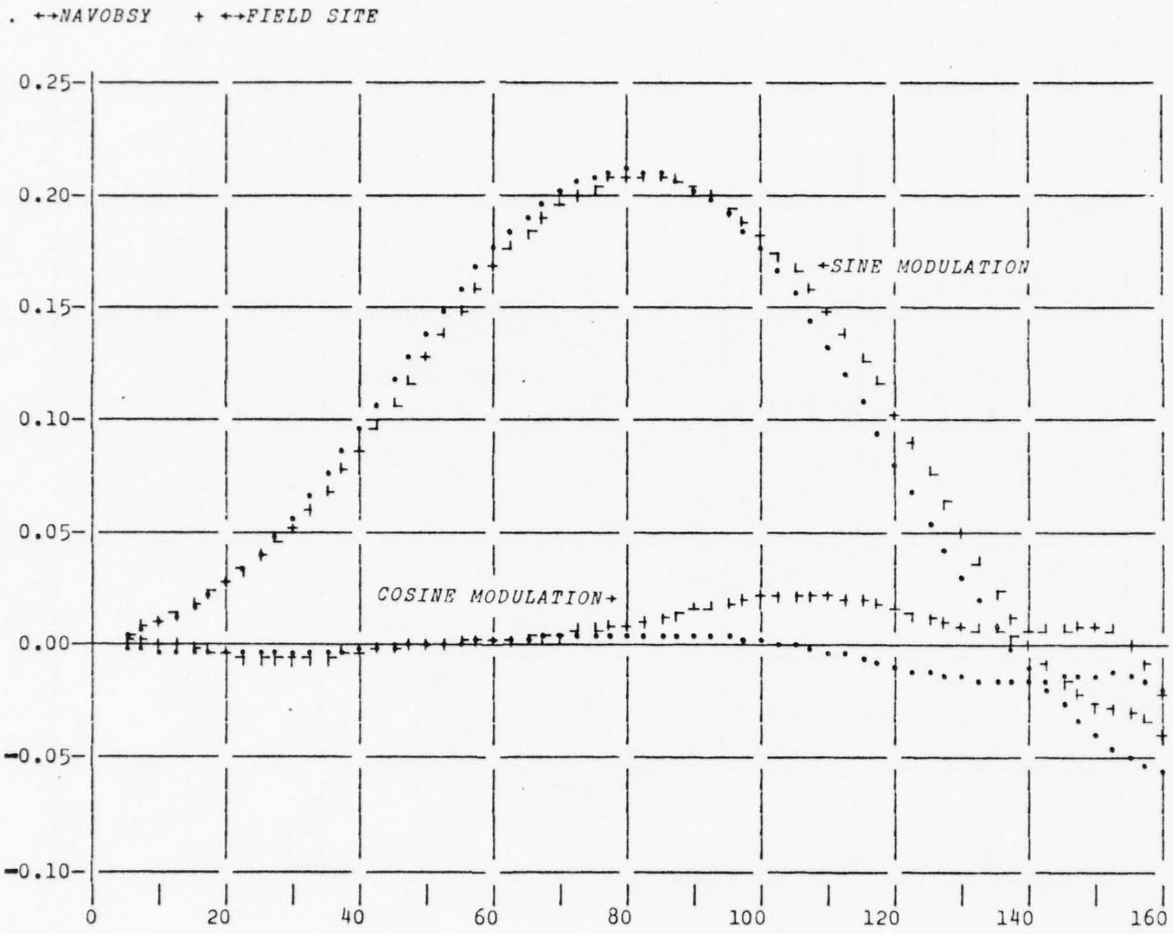


Fig. E-29 Sine and Cosine Modulations Observed Simultaneously at Bluefield, WV, and NAVOBSY; Data Segment 2

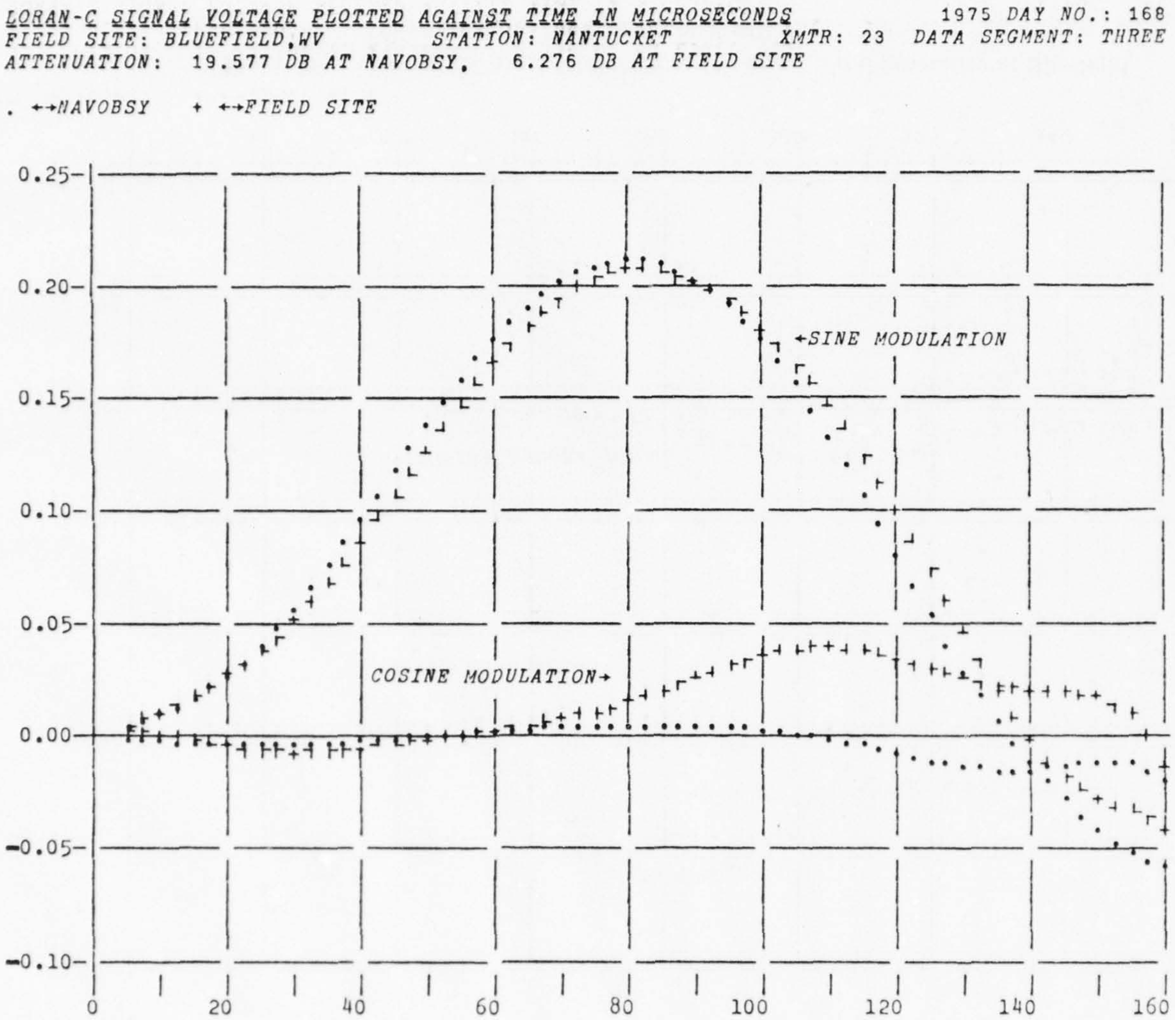


Fig. E-30 Sine and Cosine Modulations Observed Simultaneously at Bluefield, WV, and NAVOBSY; Data Segment 3

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 154
FIELD SITE: NAVOBSY,BASELINE STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: ONE
ATTENUATION: 27.590 DB AT NAVOBSY, 26.674 DB AT FIELD SITE

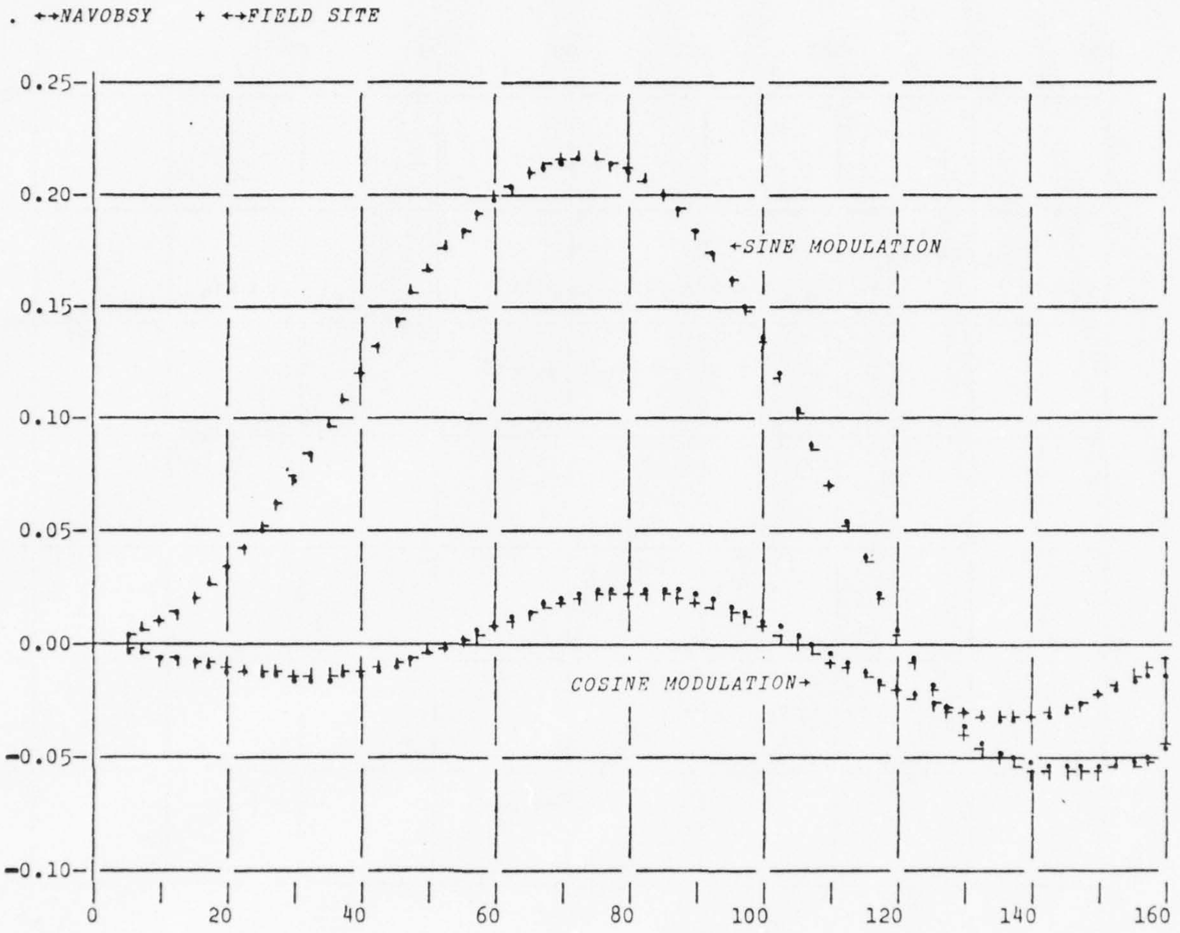


Fig. E-31 Sine and Cosine Modulations Observed Simultaneously at NAVOBSY by the Fixed and Field Site Equipment on 1975 Day No. 154; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 154
FIELD SITE: NAVOBSY,BASELINE STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 27.945 DB AT NAVOBSY, 27.046 DB AT FIELD SITE

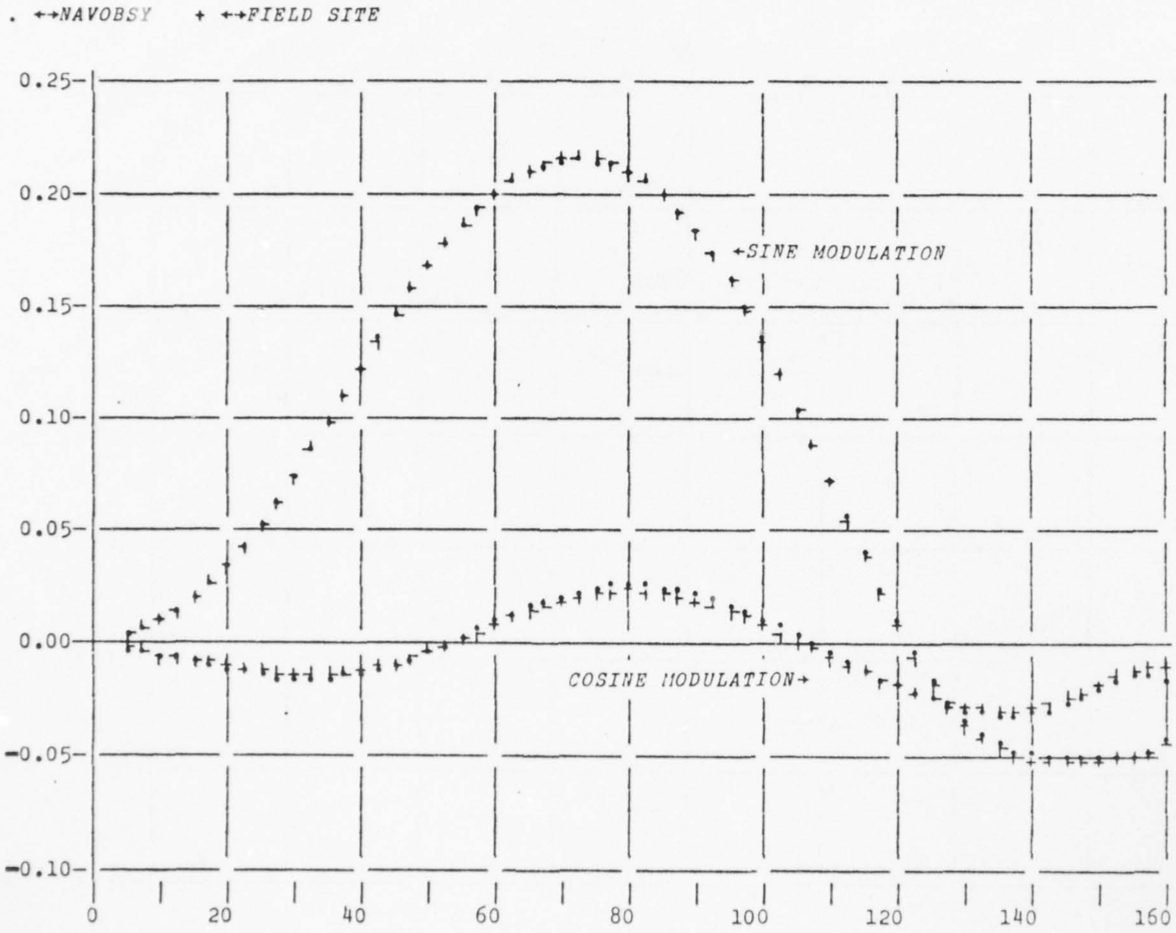


Fig. E-32 Sine and Cosine Modulations Observed Simultaneously at NAVOBSY by the Fixed and Field Site Equipment on 1975 Day No. 154; Data Segment 2

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 *DAY NO.*: 154
FIELD SITE: NAVOBSY, BASELINE STATION: CAROLINA BEACH XMTR: 19 *DATA SEGMENT: THREE*
ATTENUATION: 27.930 *DB AT NAVOBSY*, 27.004 *DB AT FIELD SITE*

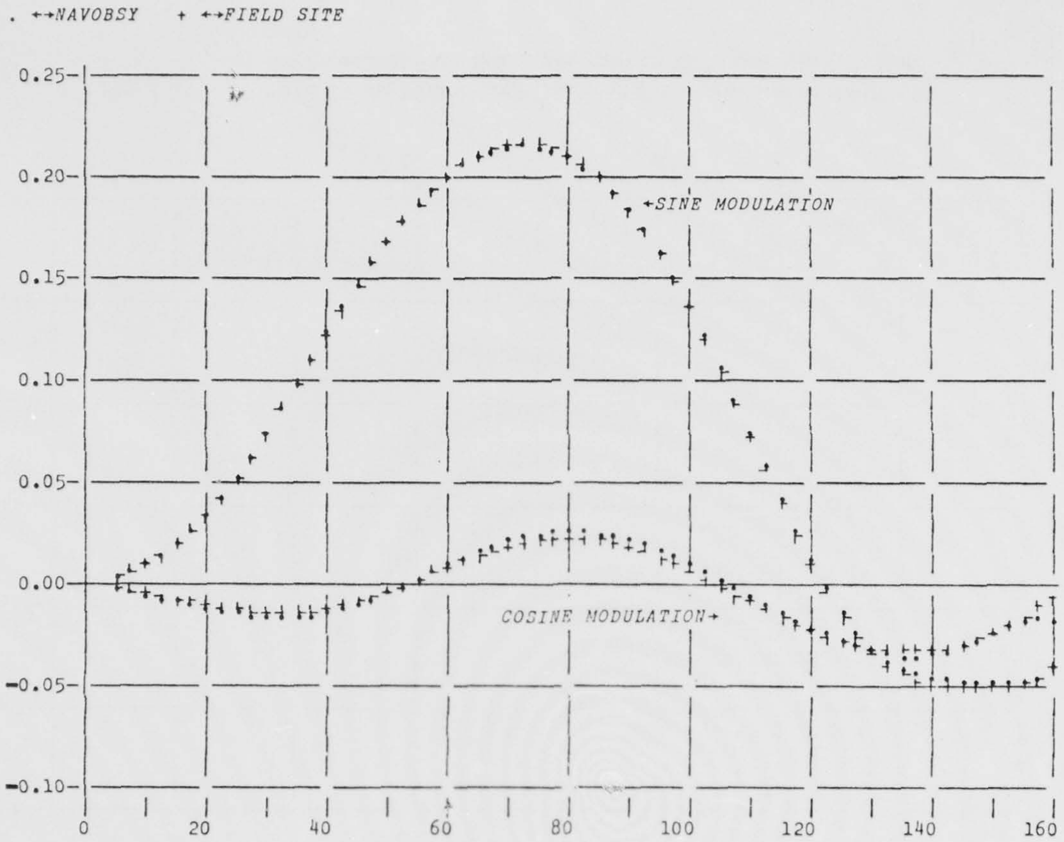


Fig. E-33 Sine and Cosine Modulations Observed Simultaneously at NAVOBSY by the Fixed and Field Site Equipment on 1975 Day No. 154; Data Segment 3

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 *DAY NO.*: 188
FIELD SITE: *NAVOBSY,BASELINE* *STATION*: *CAROLINA BEACH* *XMTR*: 19 *DATA SEGMENT*: *ONE*
ATTENUATION: 27.849 *DB AT NAVOBSY*, 26.837 *DB AT FIELD SITE*

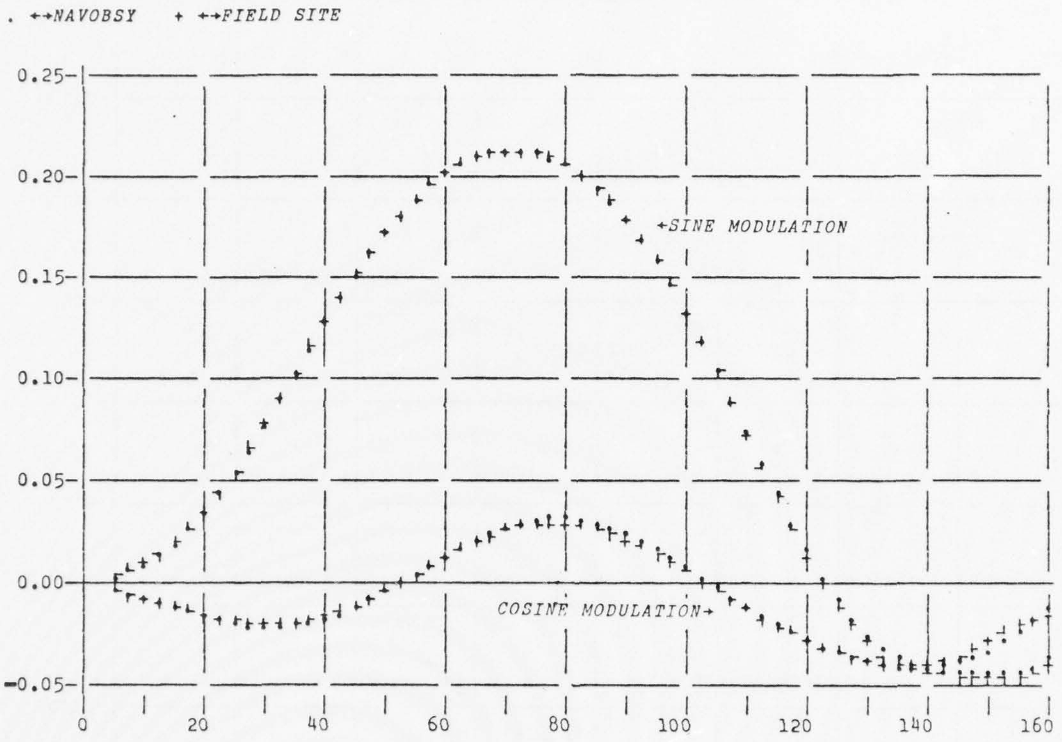
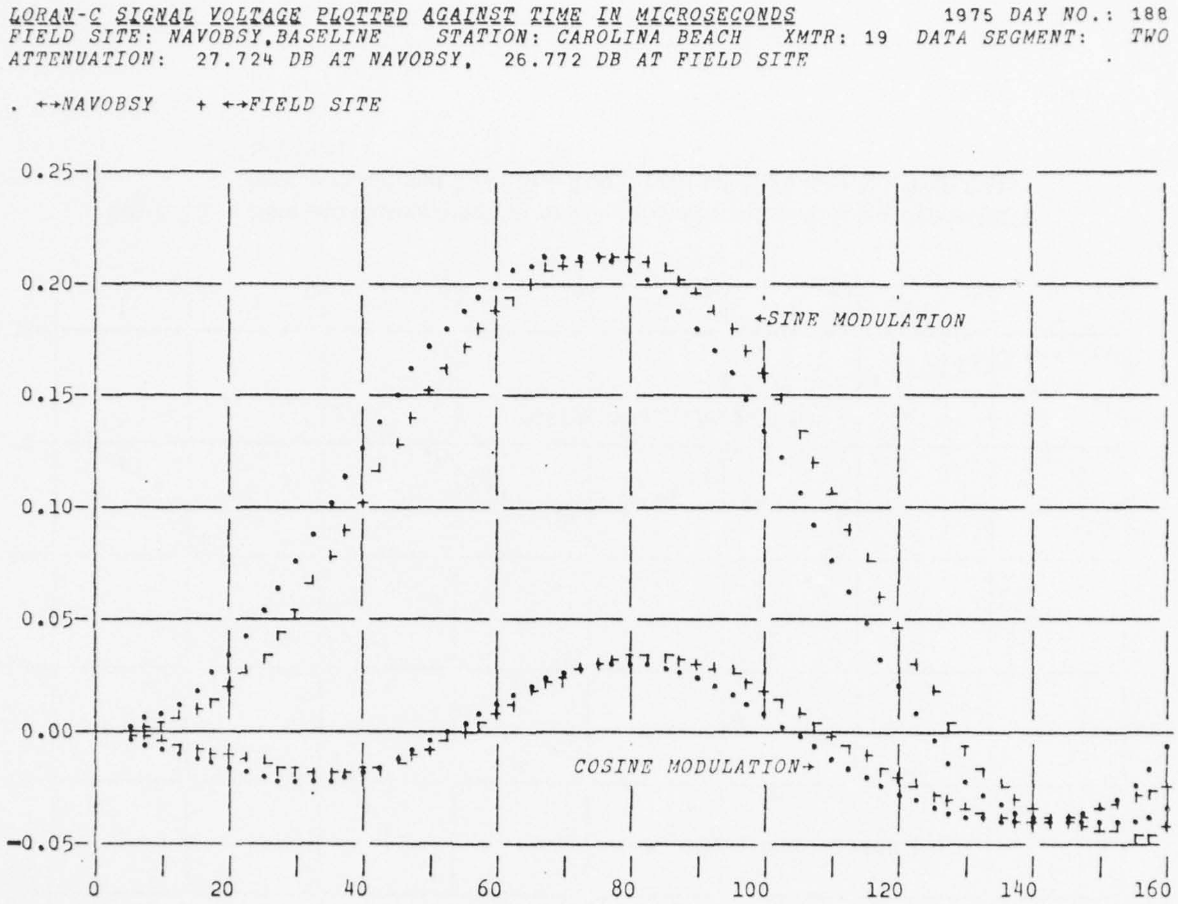


Fig. E-34 Sine and Cosine Modulations Observed Simultaneously at NAVOBSY by the Fixed and Field Site Equipment on 1975 Day No. 188; Data Segment 1



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LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS          1975 DAY NO.: 188
FIELD SITE: NAVOBSY,BASELINE    STATION: CAROLINA BEACH   XMTR: 19  DATA SEGMENT:   TWO
ATTENUATION:  27.724 DB AT NAVOBSY,  26.772 DB AT FIELD SITE

. ←→NAVOBSY     + ←→FIELD SITE
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Fig. E-35 Sine and Cosine Modulations Observed Simultaneously at NAVOBSY by the Fixed and Field Site Equipment on 1975 Day No. 188; Data Segment 2

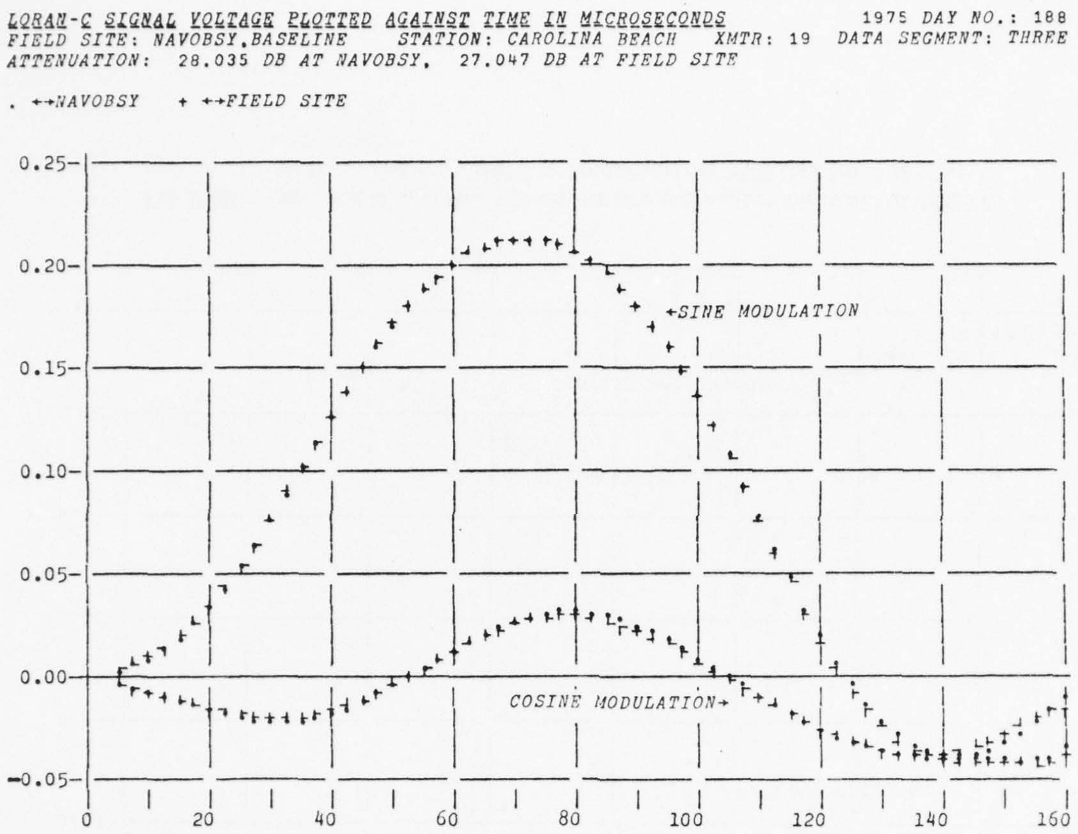


Fig. E-36 Sine and Cosine Modulations Observed Simultaneously at NAVOBSY by the Fixed and Field Site Equipment on 1975 Day No. 188; Data Segment 3

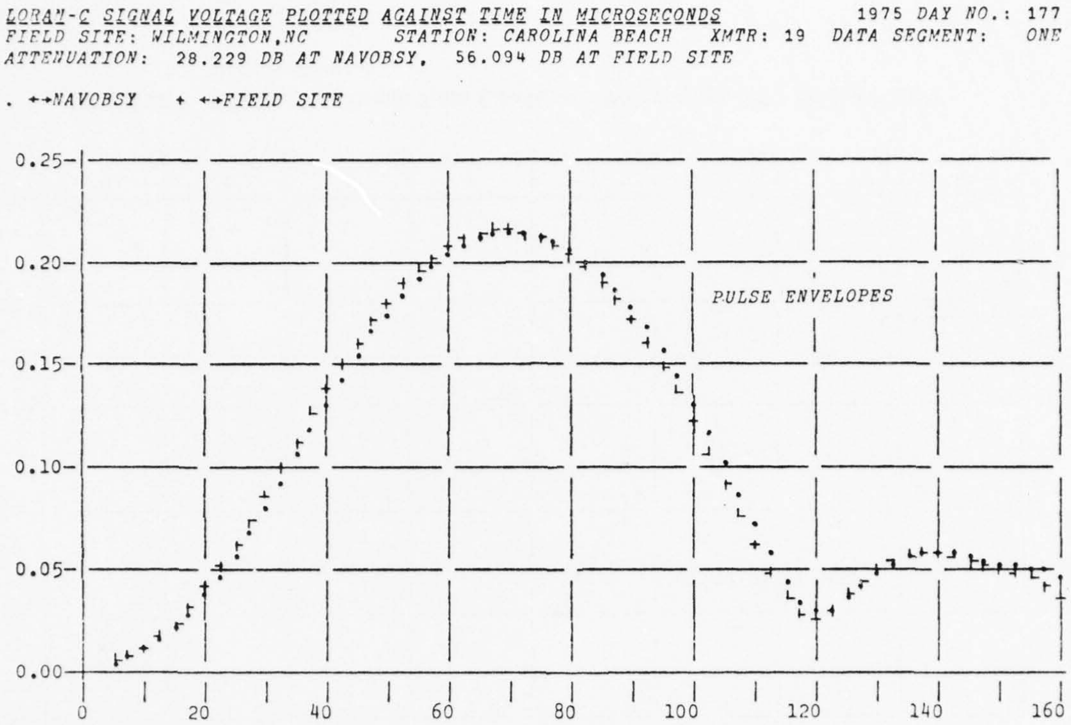


Fig. E-37 The Carolina Beach Pulse Envelope at Wilmington, NC, and NAVOBSY; *Data Segment 1*

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 177
FIELD SITE: WILMINGTON,NC STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 28.207 DB AT NAVOBSY, 56.089 DB AT FIELD SITE

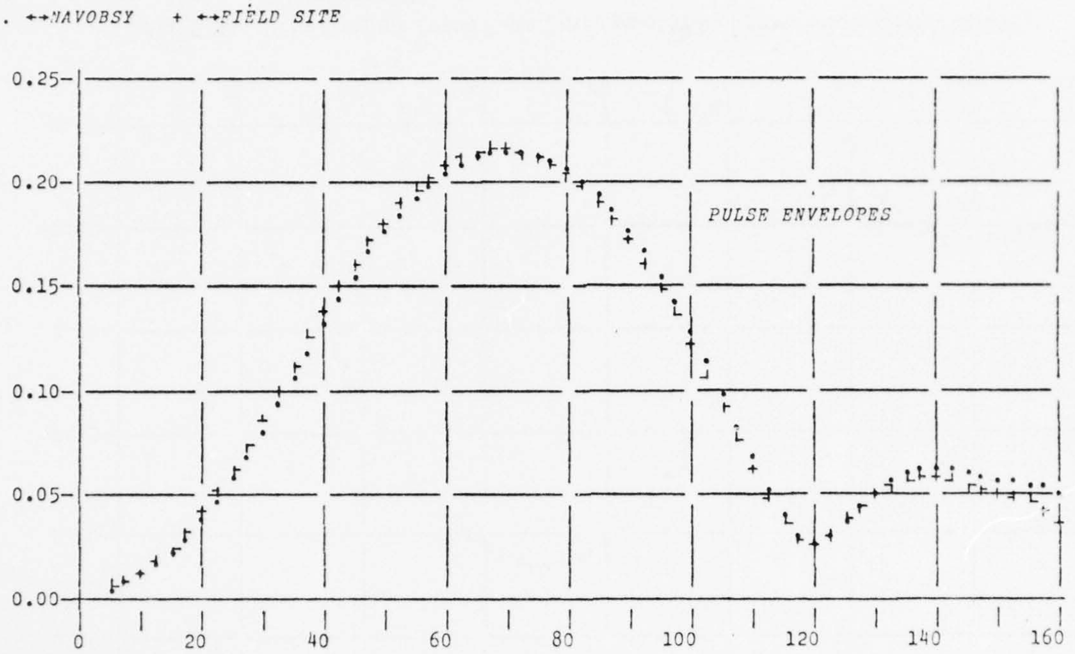


Fig. E-38 The Carolina Beach Pulse Envelope at Wilmington, NC, and NAVOBSY; Data Segment 2

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 177
FIELD SITE: WILMINGTON,NC STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: THREE
ATTENUATION: 28.133 DB AT NAVOBSY, 56.018 DB AT FIELD SITE

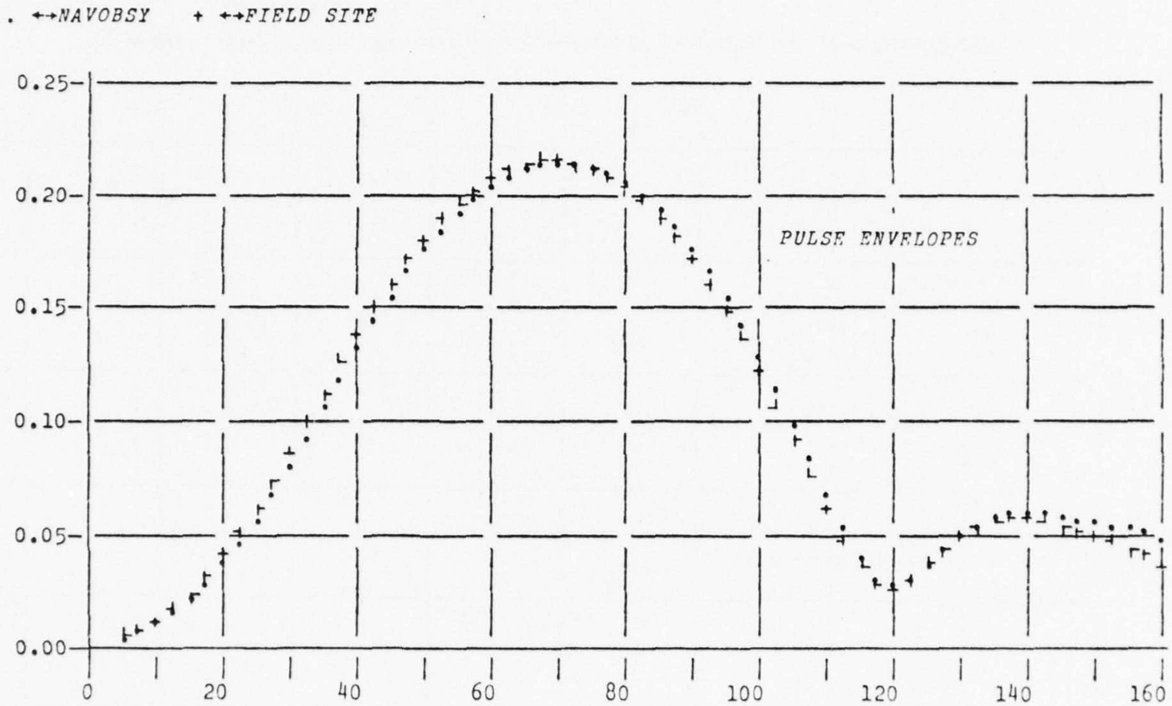


Fig. E-39 The Carolina Beach Pulse Envelope at Wilmington, NC, and NAVOBSY; Data Segment 3

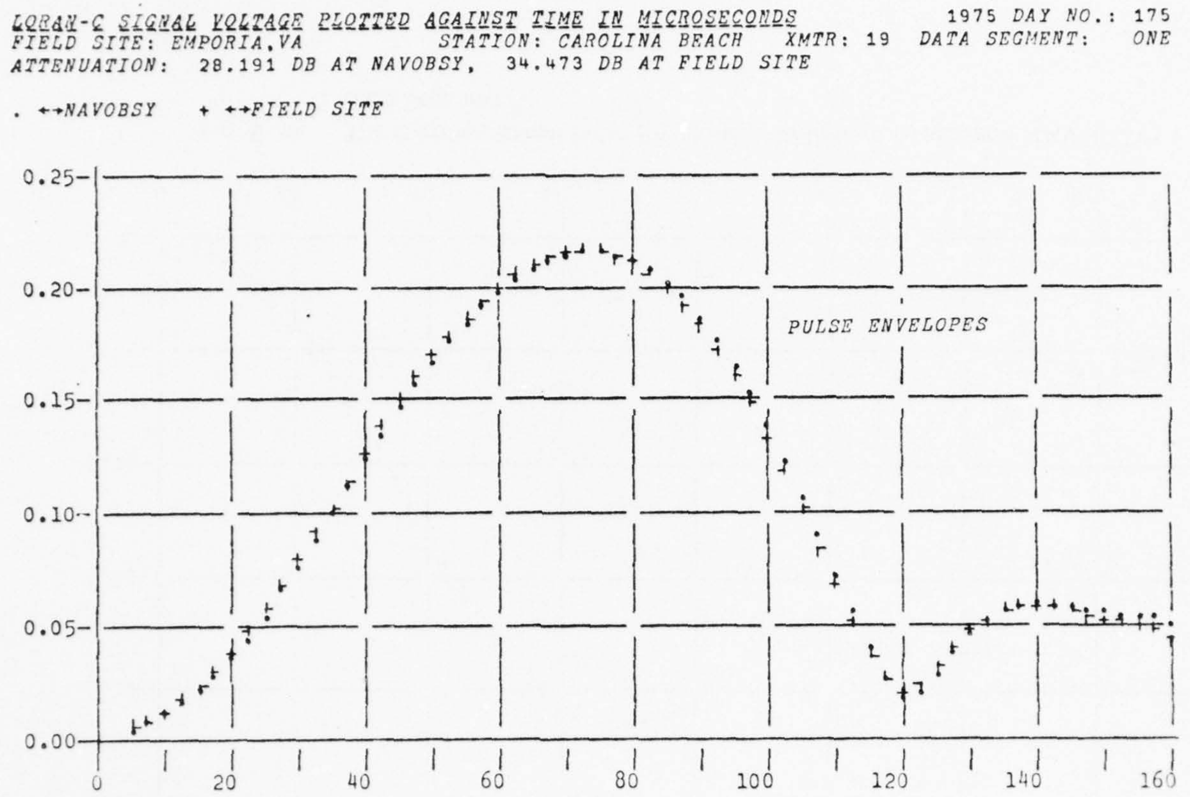


Fig. E-40 The Carolina Beach Pulse Envelope at Emporia, VA, and NAVOBSY; Data Segment 1

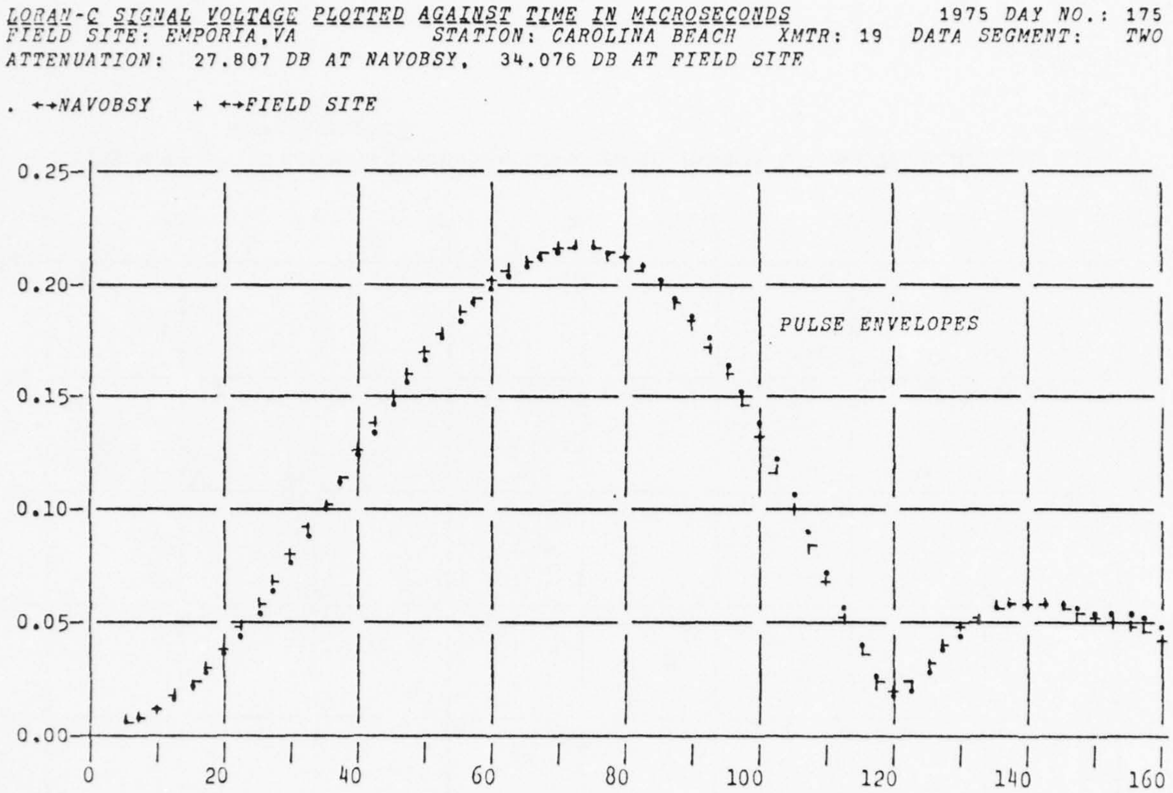


Fig. E-41 The Carolina Beach Pulse Envelope at Emporia, VA, and NAVOBSY; Data Segment 2

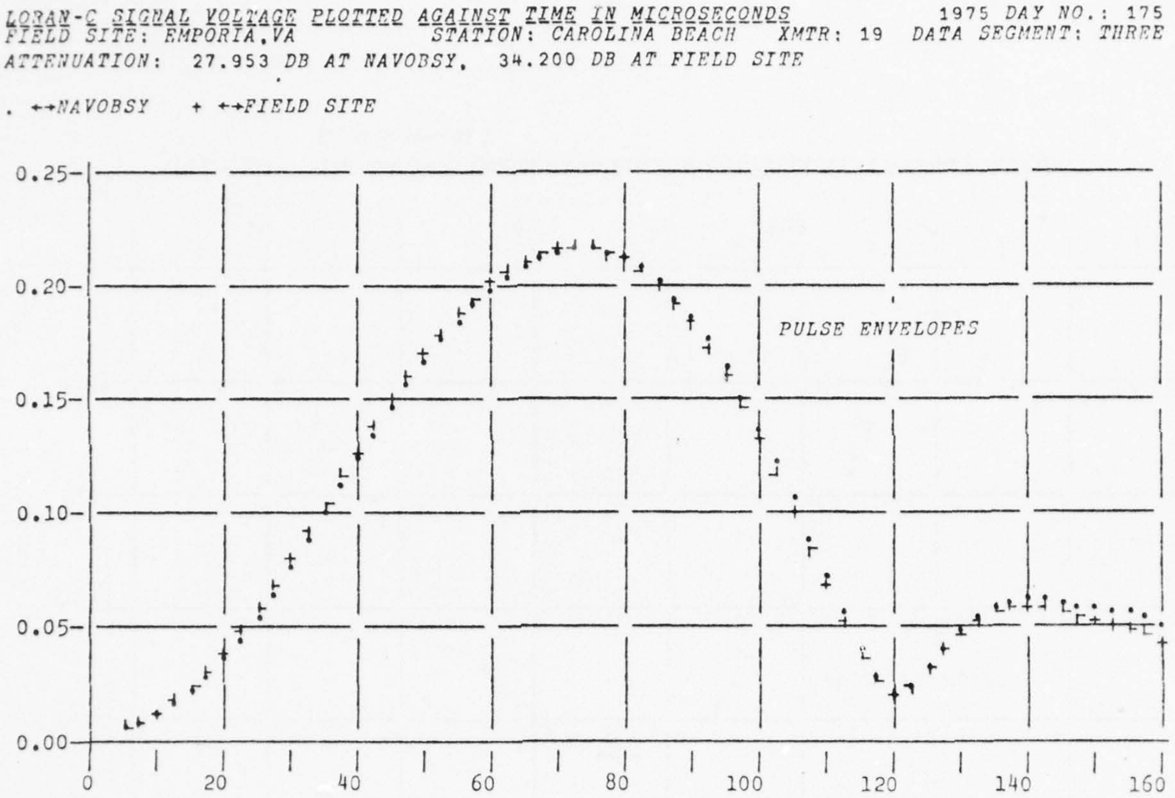


Fig. E-42 The Carolina Beach Pulse Envelope at Emporia, VA, and NAVOBSY; Data Segment 3

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 183
FIELD SITE: TOWANDA,PA STATION: CAROLINA BEACH XMTR: 20 DATA SEGMENT: ONE
ATTENUATION: 27.692 DB AT NAVOBSY, 15.577 DB AT FIELD SITE

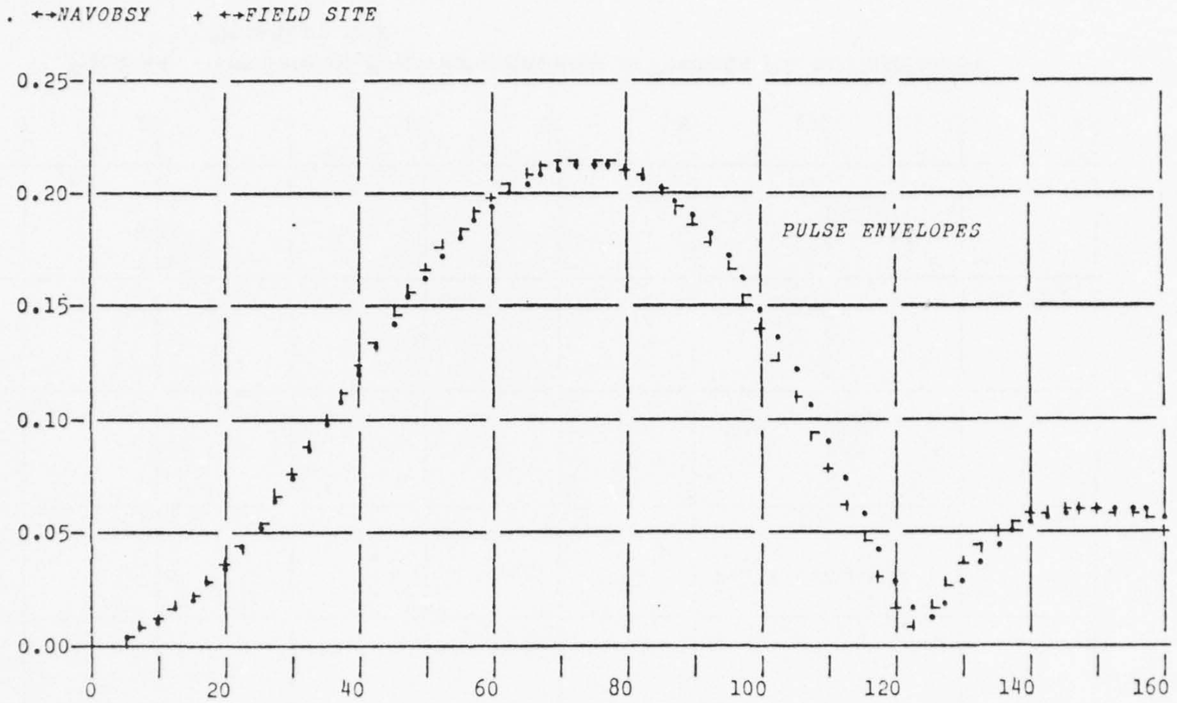
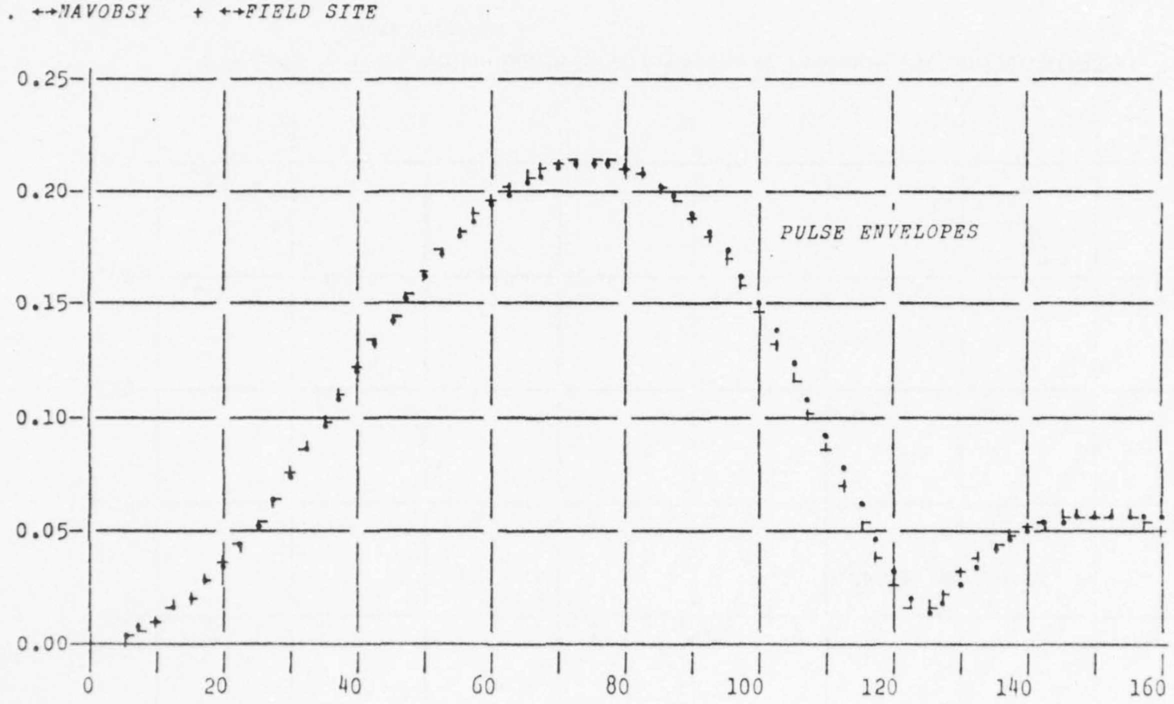


Fig. E-43 The Carolina Beach Pulse Envelope at Towanda, PA, and NAVOBSY; Data Segment 1



LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 183
FIELD SITE: TOWANDA,PA STATION: CAROLINA BEACH XMTR: 20 DATA SEGMENT: TWO
ATTENUATION: 27.765 DB AT NAVOBSY, 15.763 DB AT FIELD SITE

Fig. E-44 The Carolina Beach Pulse Envelope at Towanda, PA, and NAVOBSY; Data Segment 2

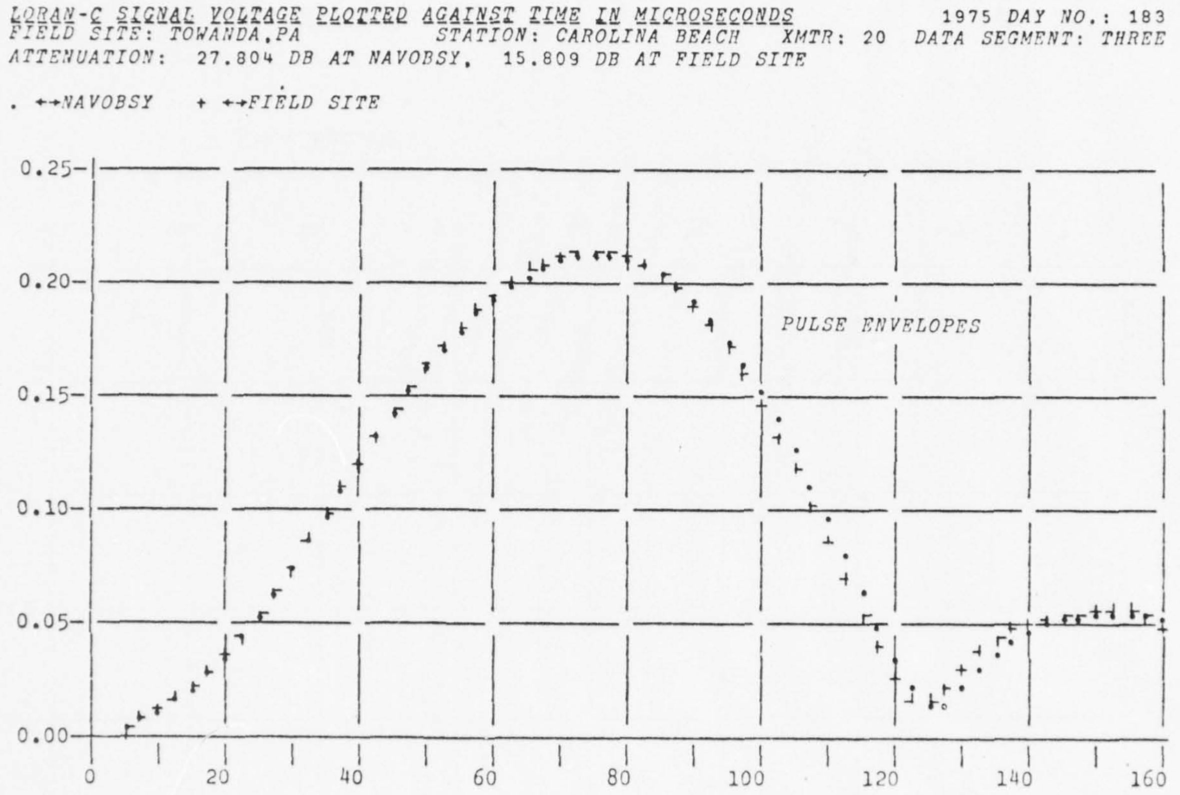


Fig. E-45 The Carolina Beach Pulse Envelope at Towanda, PA, and NAVOBSY; Data Segment 3

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 181
FIELD SITE: DEXTER,NY STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: ONE
ATTENUATION: 28.393 DB AT NAVOBSY, 8.755 DB AT FIELD SITE

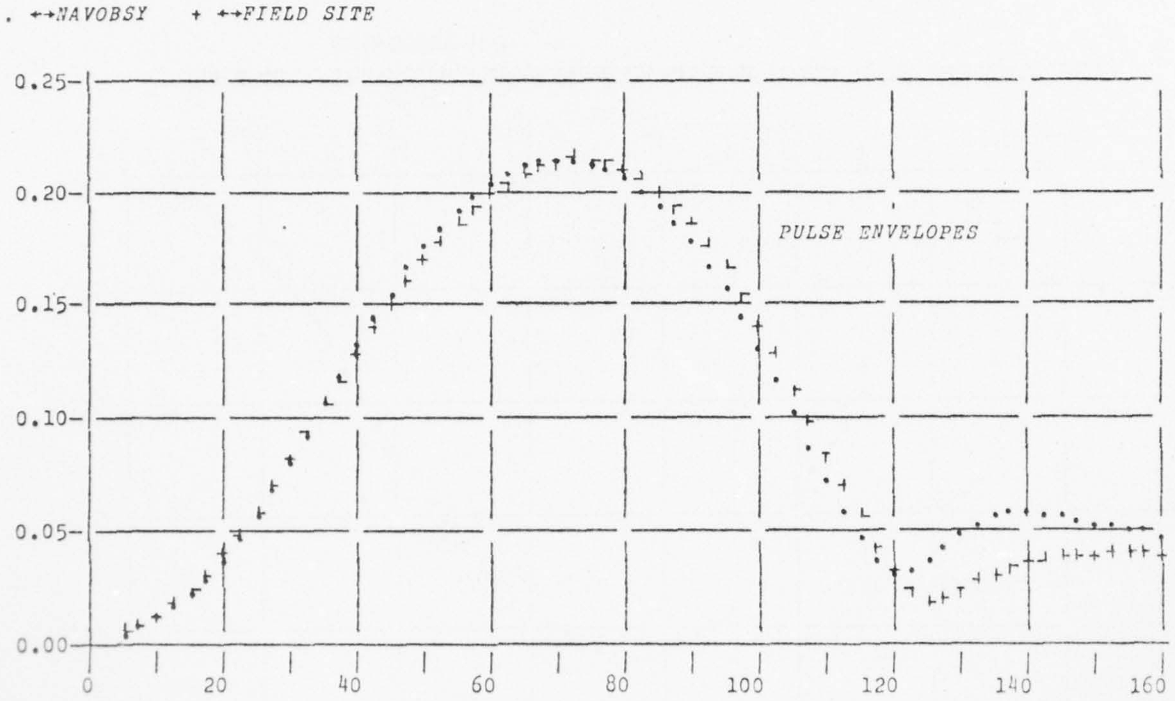


Fig. E-46 The Carolina Beach Pulse Envelope at Dexter, NY, and NAVOBSY; Data Segment 1

AD-A040 320 JOHNS HOPKINS UNIV LAUREL MD APPLIED PHYSICS LAB F/G 17/7
EXPERIMENTAL RESEARCH ON THE PROPAGATION OF LORAN-C SIGNALS. VO--ETC(U)
JAN 77 L F FEHLNER, T W JERARDI, T A MCCARTY N00017-72-C-4401
UNCLASSIFIED APL/JHU-TG-1298D NL

4 OF 5
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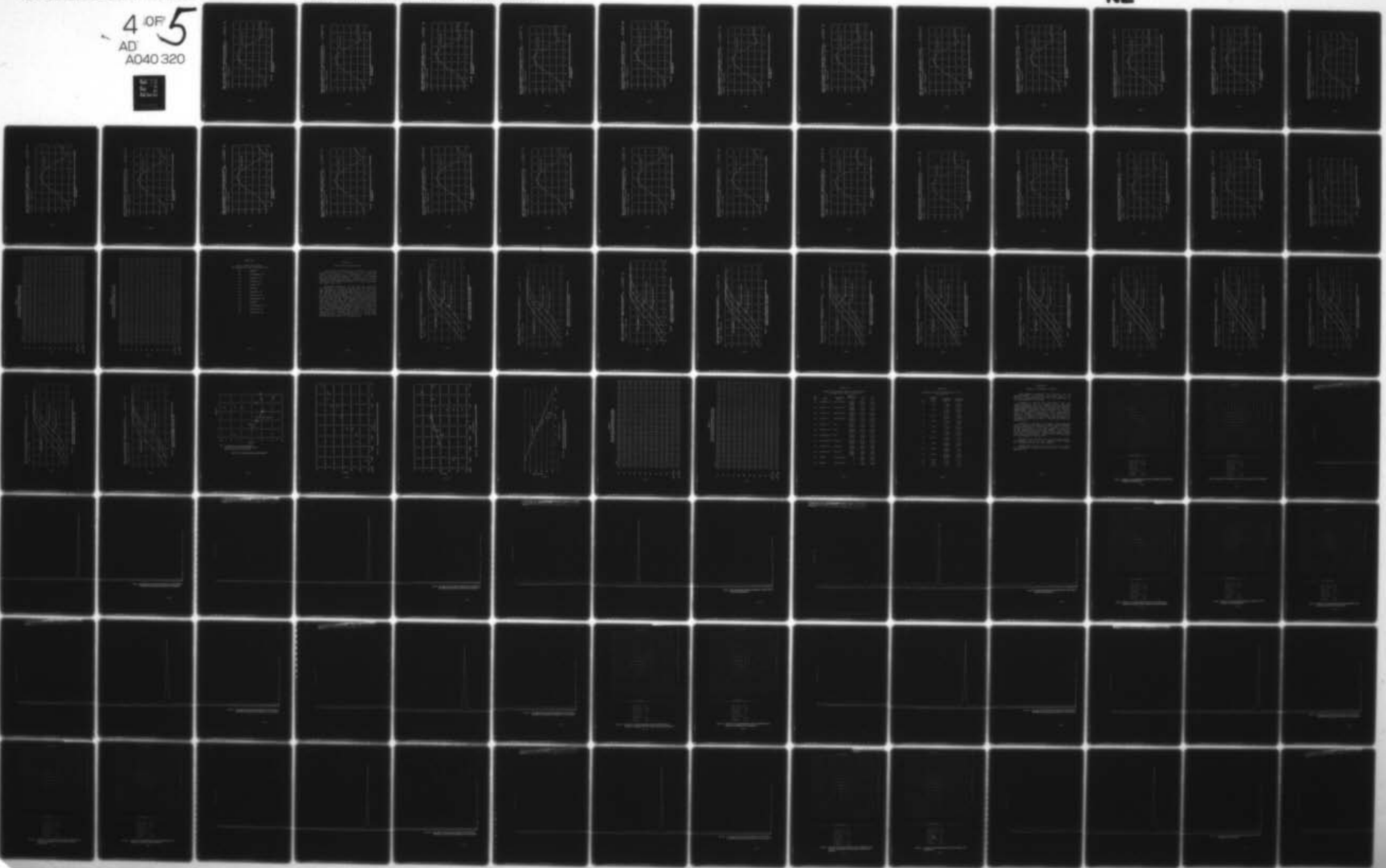
A040 320



OF 5

0320

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 181
FIELD SITE: DEXTER,NY STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 28.320 DB AT NAVOBSY, 8.698 DB AT FIELD SITE

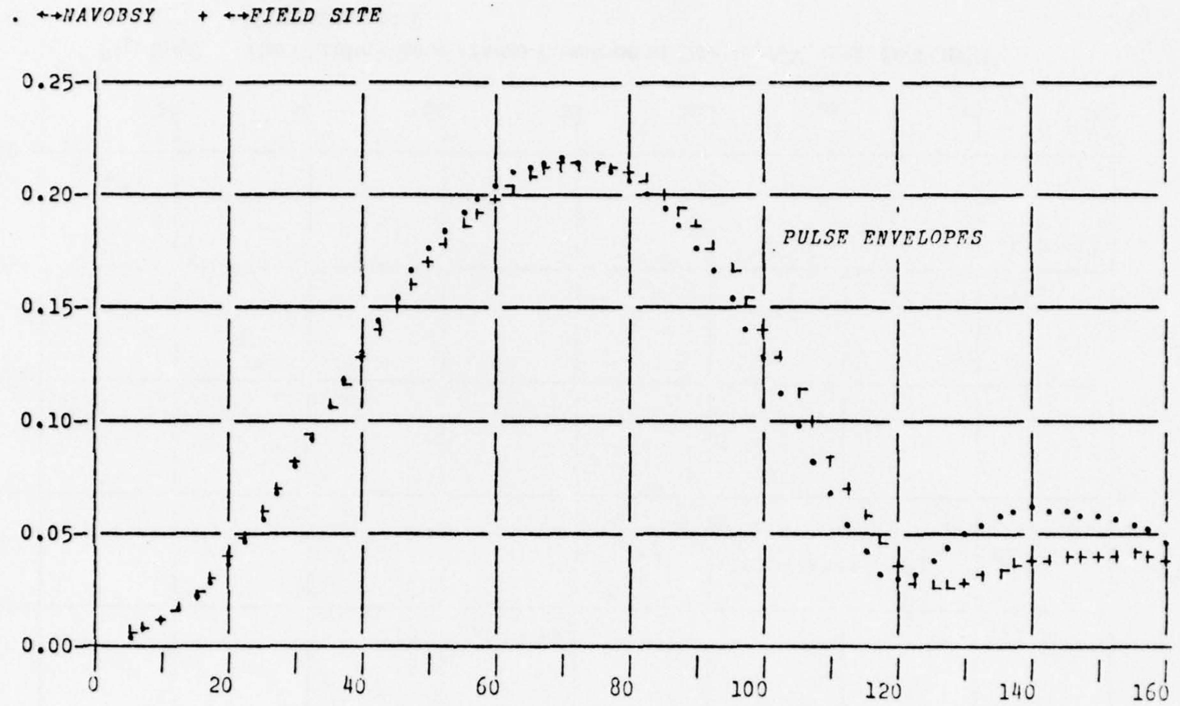


Fig. E-47 The Carolina Beach Pulse Envelope at Dexter, NY, and NAVOBSY; Data Segment 2

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 181
FIELD SITE: DEXTER,NY STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: THREE
ATTENUATION: 28.343 DB AT NAVOBSY, 8.719 DB AT FIELD SITE

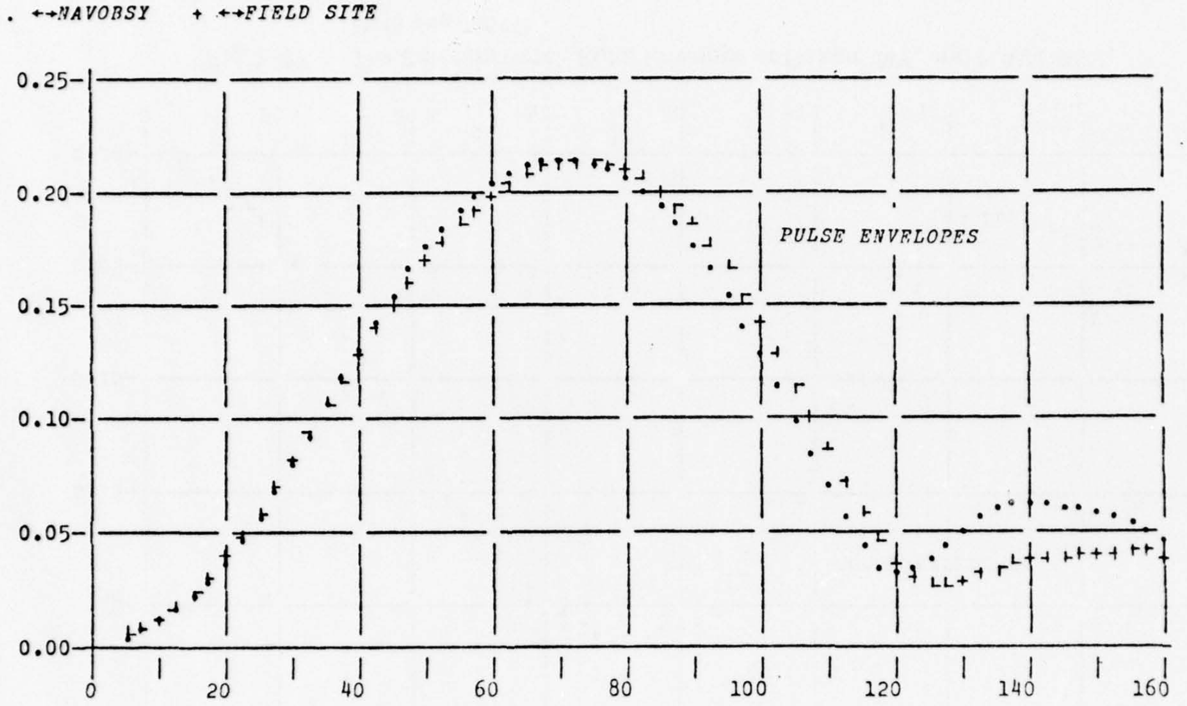


Fig. E-48 The Carolina Beach Pulse Envelope at Dexter, NY, and NAVOBSY; Data Segment 3

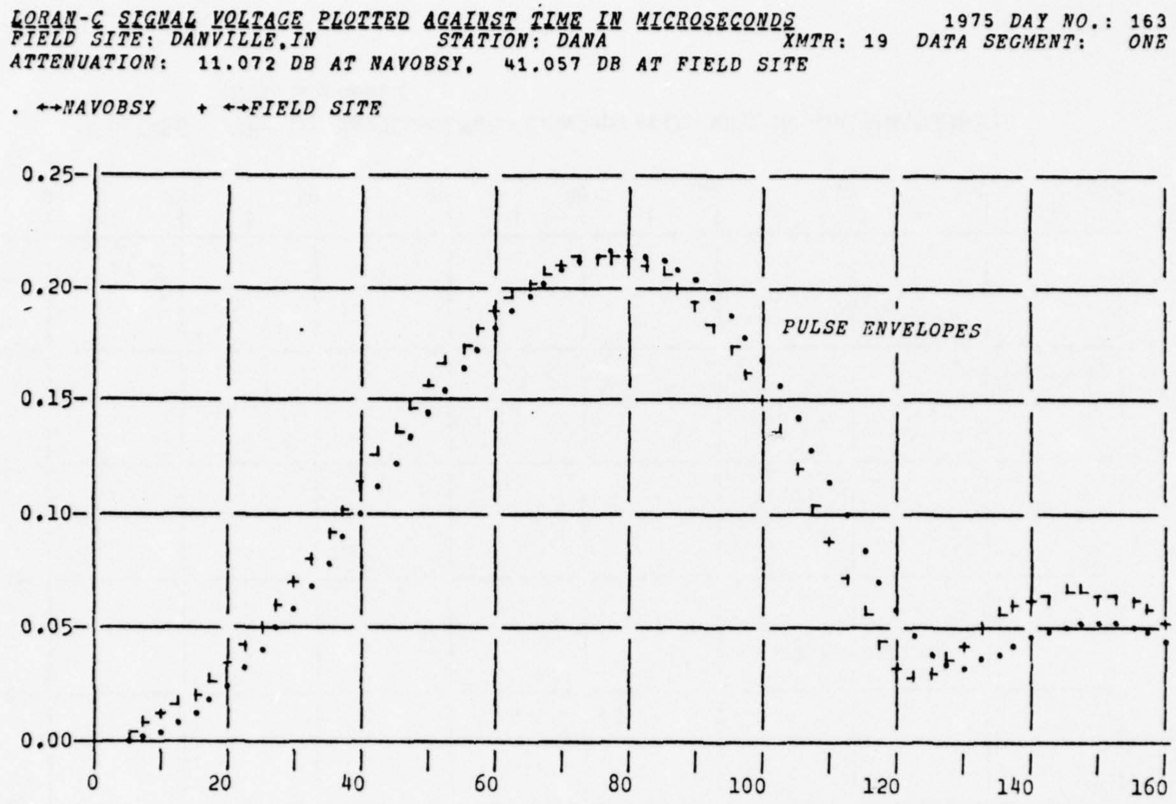


Fig. E-49 The Carolina Beach Pulse Envelope at Danville, IN, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 163
FIELD SITE: DANVILLE,IN STATION: DANA XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 11.089 DB AT NAVOBSY, 41.082 DB AT FIELD SITE

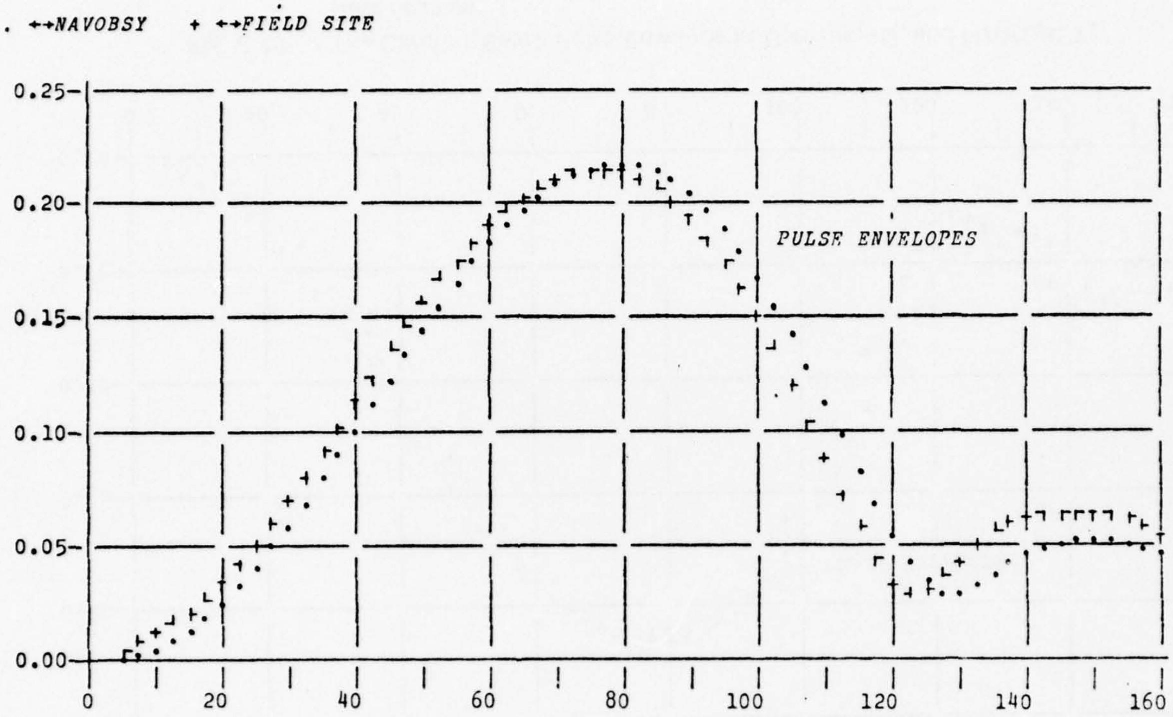


Fig. E-50 The Carolina Beach Pulse Envelope at Danville, IN, and NAVOBSY; Data Segment 2

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 163
FIELD SITE: DANVILLE,IN STATION: DANA XMTR: 19 DATA SEGMENT: THREE
ATTENUATION: 11.196 DB AT NAVOBSY, 41.101 DB AT FIELD SITE

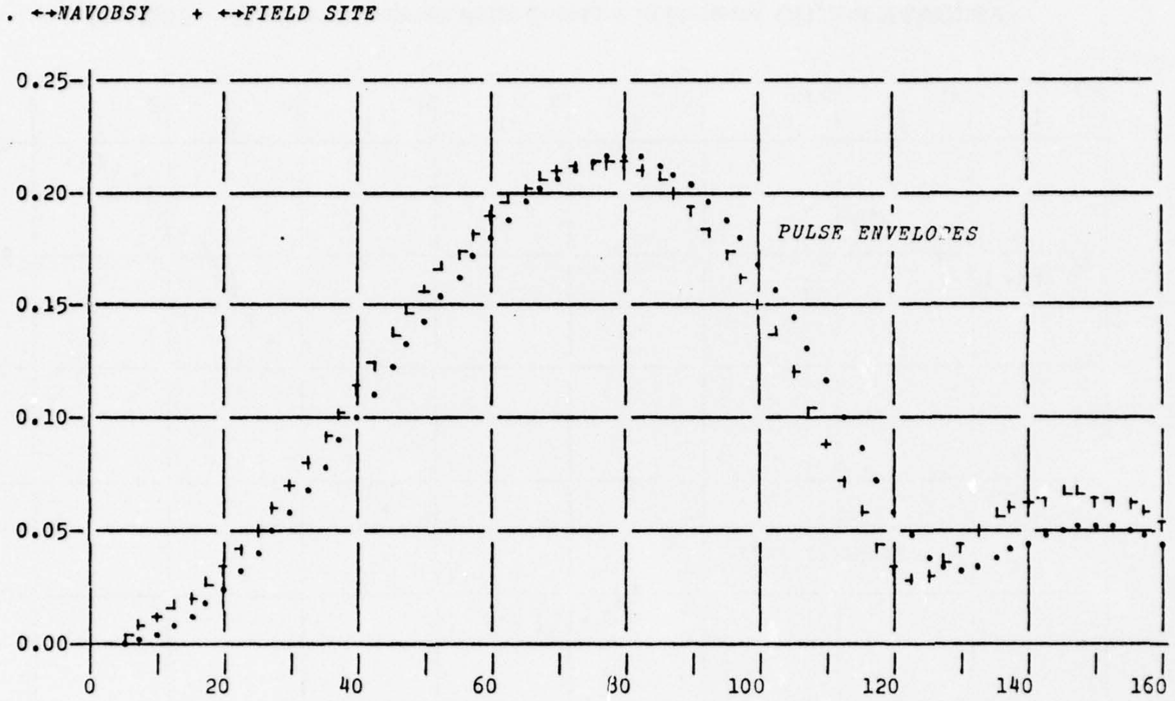


Fig. E-51 The Carolina Beach Pulse Envelope at Danville, IN, and NAVOBSY; Data Segment 3

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 161
FIELD SITE: MARIETTA,OH STATION: DANA XMTR: 19 DATA SEGMENT: ONE
ATTENUATION: 10.400 DB AT NAVOBSY, 21.880 DB AT FIELD SITE

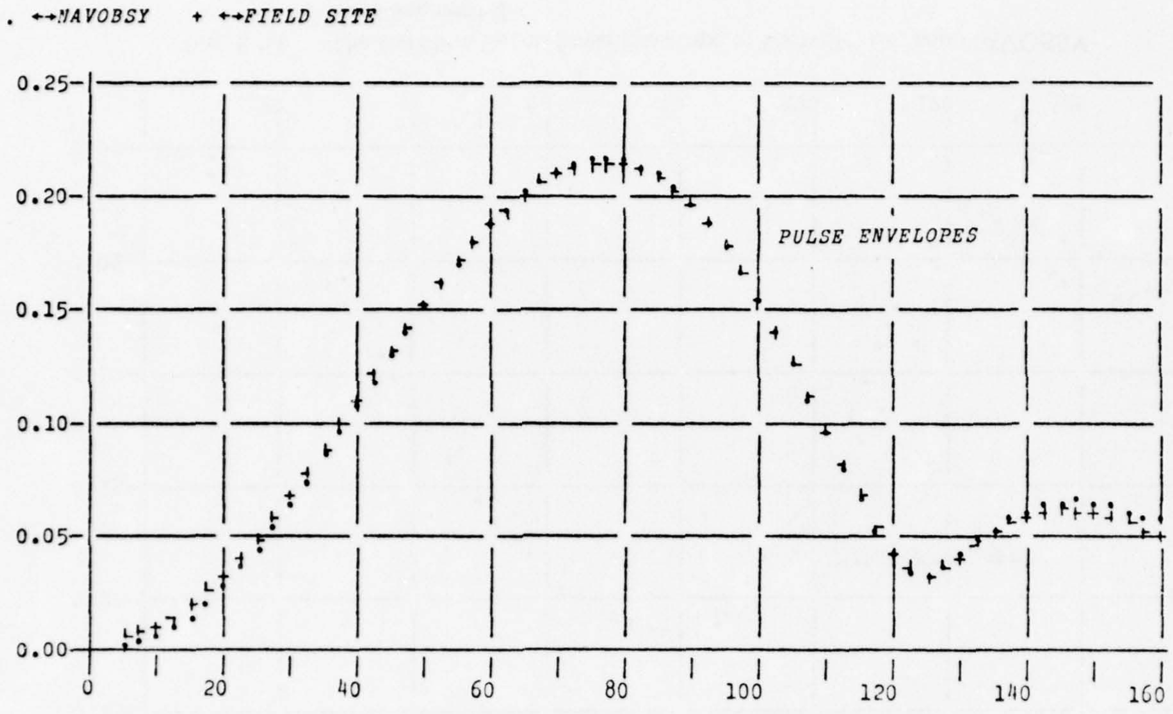


Fig. E-52 The Carolina Beach Pulse Envelope at Marietta, OH, and NAVOBSY; Data Segment 1

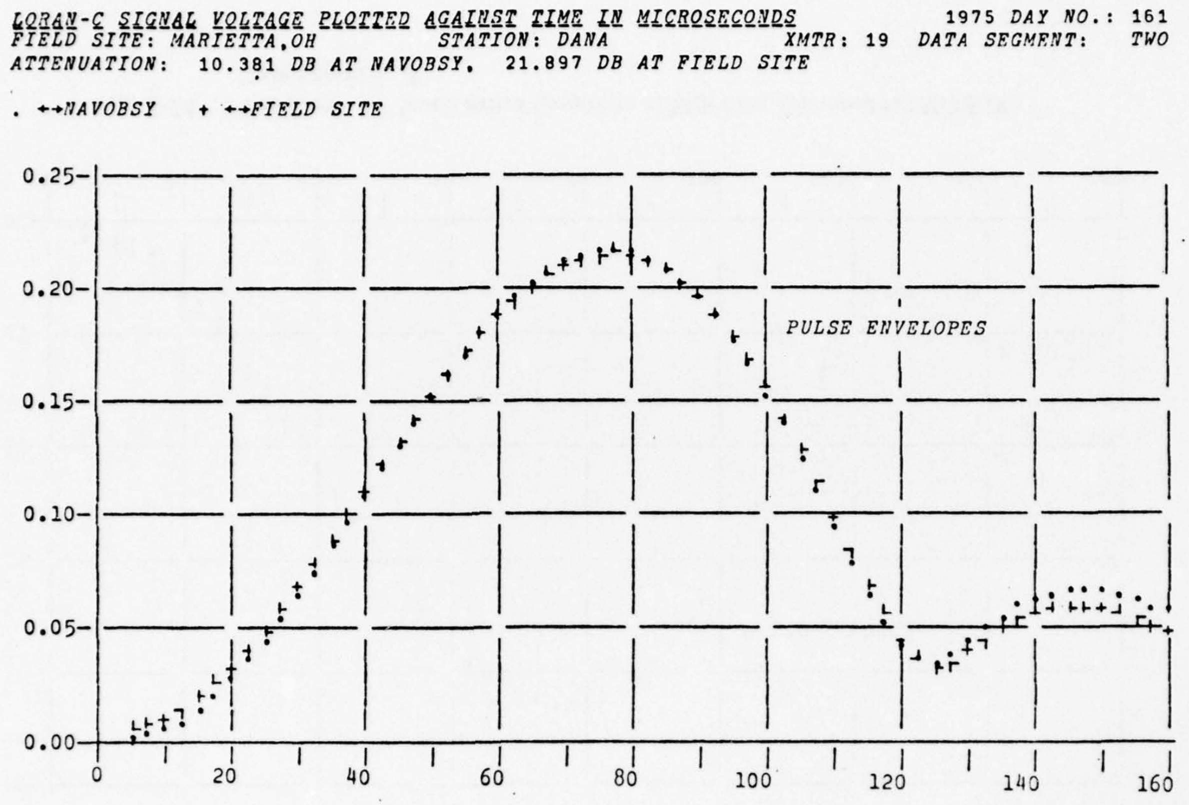


Fig. E-53 The Carolina Beach Pulse Envelope at Marietta, OH, and NAVOBSY; Data Segment 2

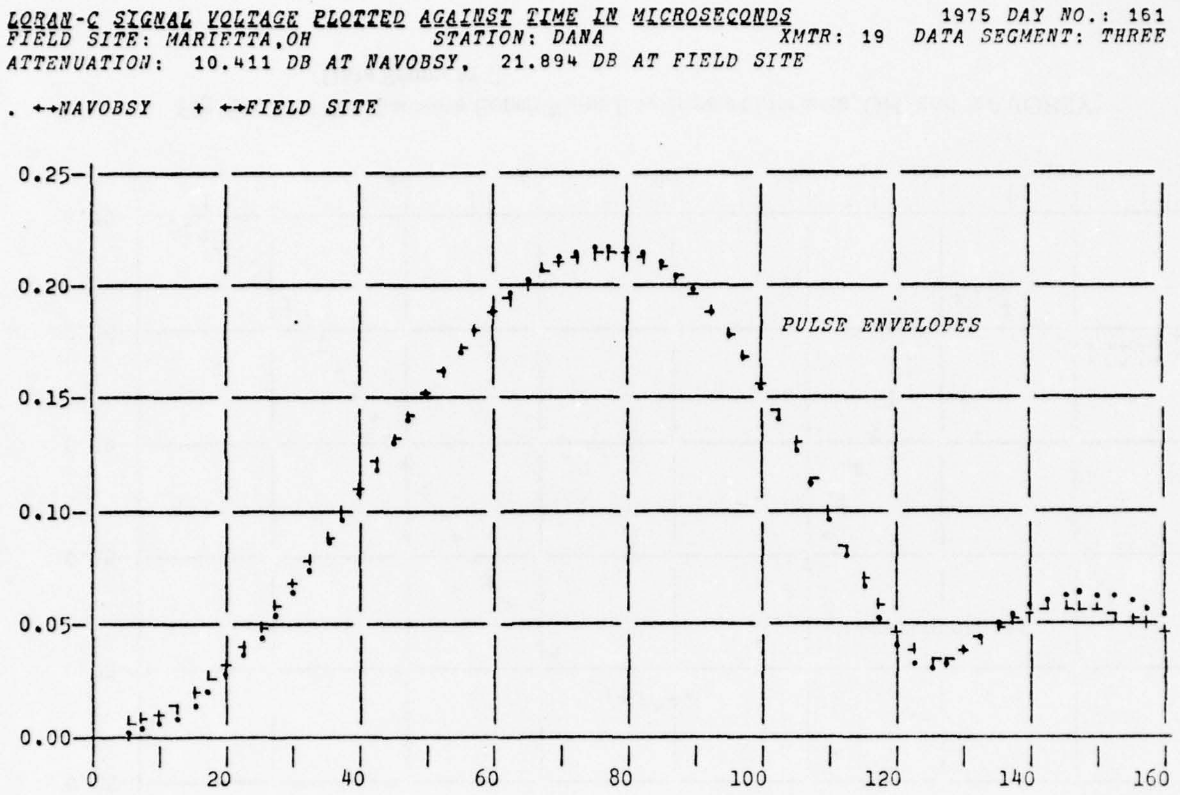


Fig. E-54 The Carolina Beach Pulse Envelope at Marietta, OH, and NAVOBSY; Data Segment 3

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 156
FIELD SITE: GEORGETOWN,DE STATION: DANA XMTR: 19 DATA SEGMENT: ONE
ATTENUATION: 10.414 DB AT NAVOBSY, 7.474 DB AT FIELD SITE

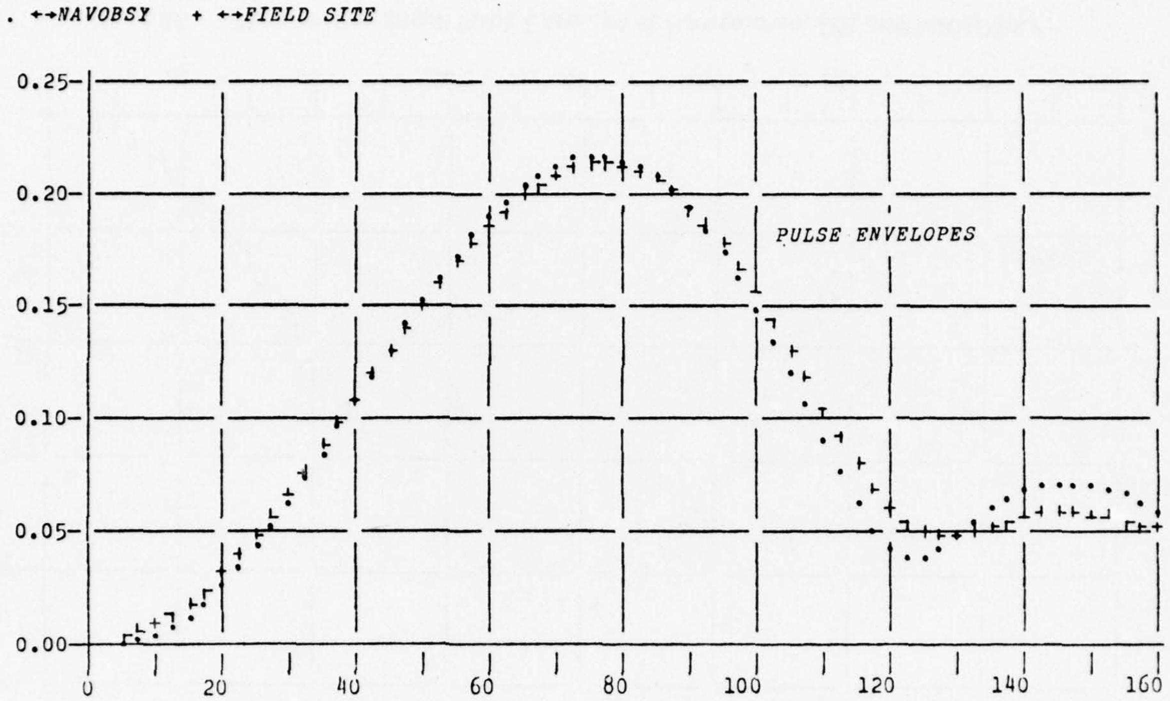


Fig. E-55 The Carolina Beach Pulse Envelope at Georgetown, DE, and NAVOBSY; Data Segment 1

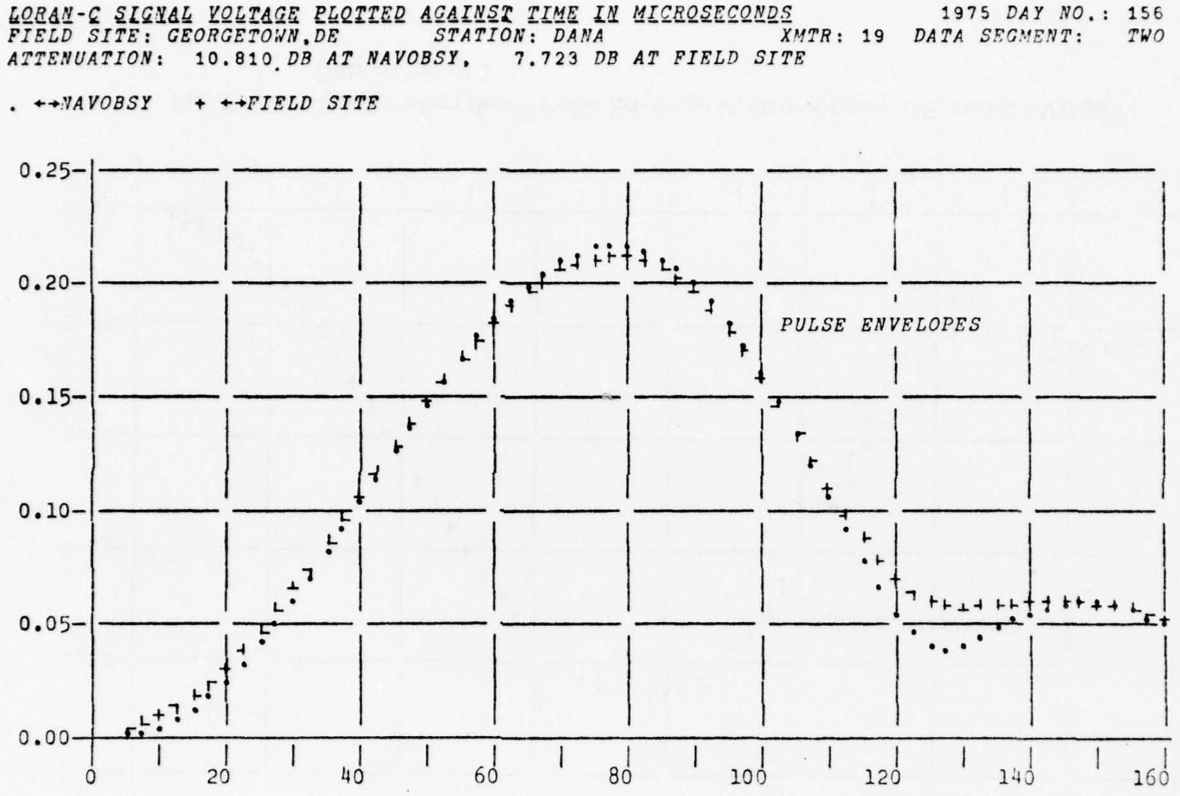
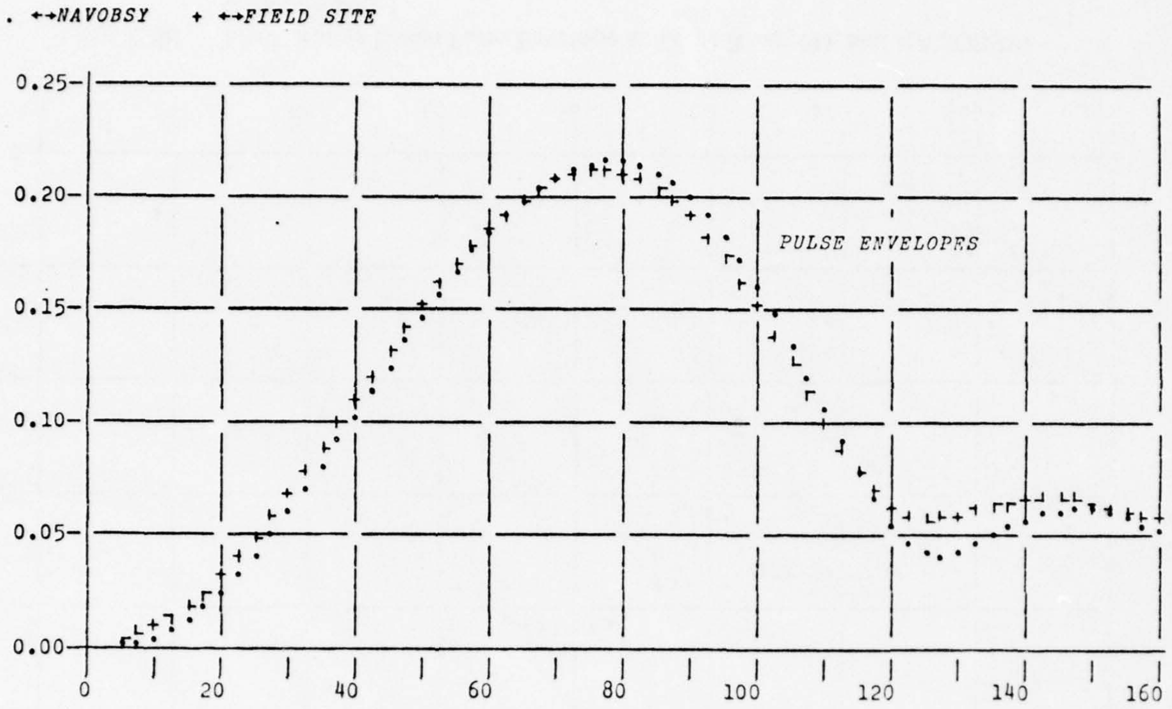


Fig. E-56 The Carolina Beach Pulse Envelope at Georgetown, DE, and NAVOBSY; Data Segment 2



LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 156
FIELD SITE: GEORGETOWN,DE STATION: DANA XMTR: 19 DATA SEGMENT: THREE
ATTENUATION: 10.928 DB AT NAVOBSY, 7.472 DB AT FIELD SITE

Fig. E-57 The Carolina Beach Pulse Envelope at Georgetown, DE, and NAVOBSY; Data Segment 3

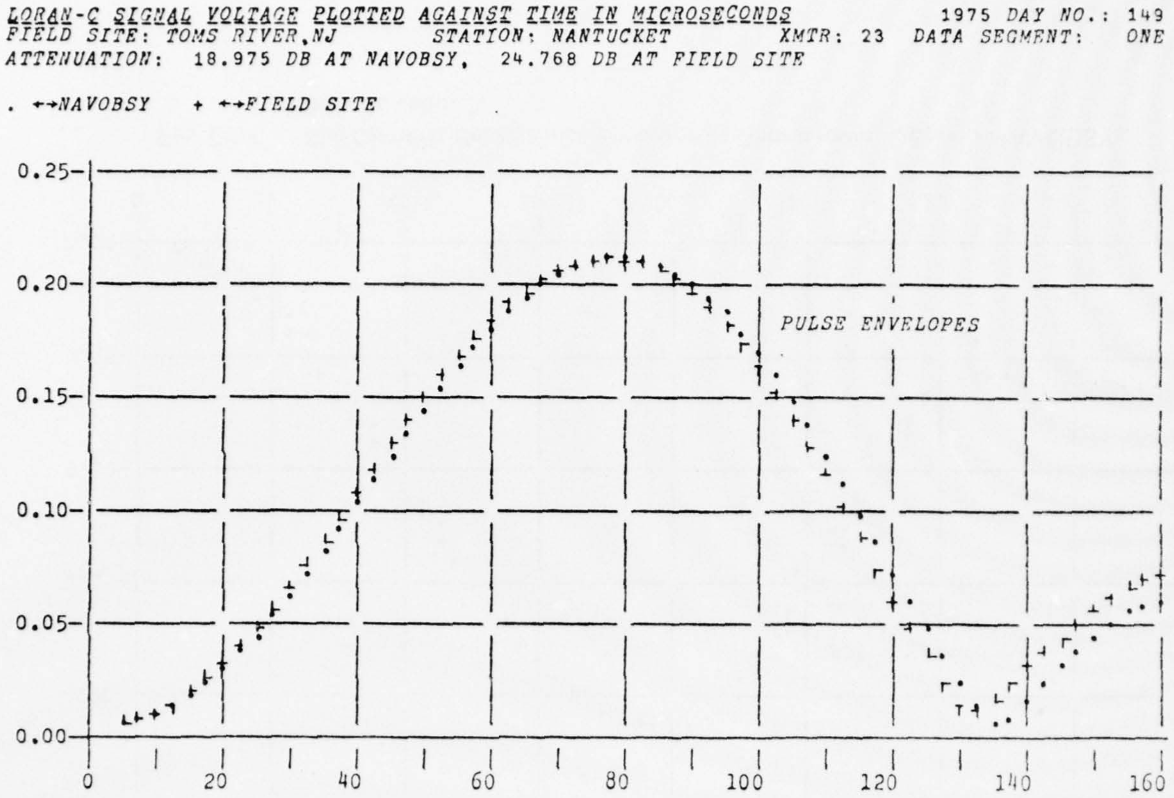


Fig. E-58 The Carolina Beach Pulse Envelope at Toms River, NJ, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 149
FIELD SITE: TOMS RIVER,NJ STATION: NANTUCKET XMTR: 23 DATA SEGMENT: TWO
ATTENUATION: 19.701 DB AT NAVOBSY, 25.463 DB AT FIELD SITE

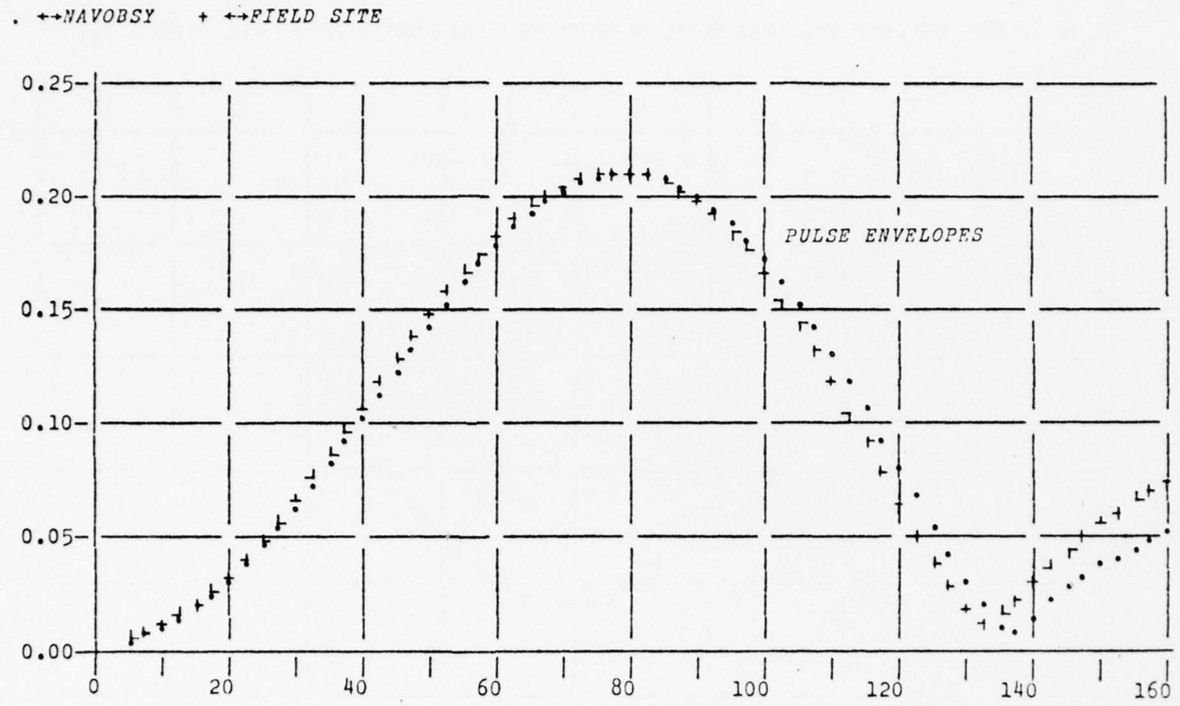


Fig. E-59 The Carolina Beach Pulse Envelope at Toms River, NJ, and NAVOBSY; Data Segment 2

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 149
FIELD SITE: TOMS RIVER,NJ STATION: NANTUCKET XMTR: 23 DATA SEGMENT: THREE
ATTENUATION: 19.837 DB AT NAVOBSY, 25.576 DB AT FIELD SITE

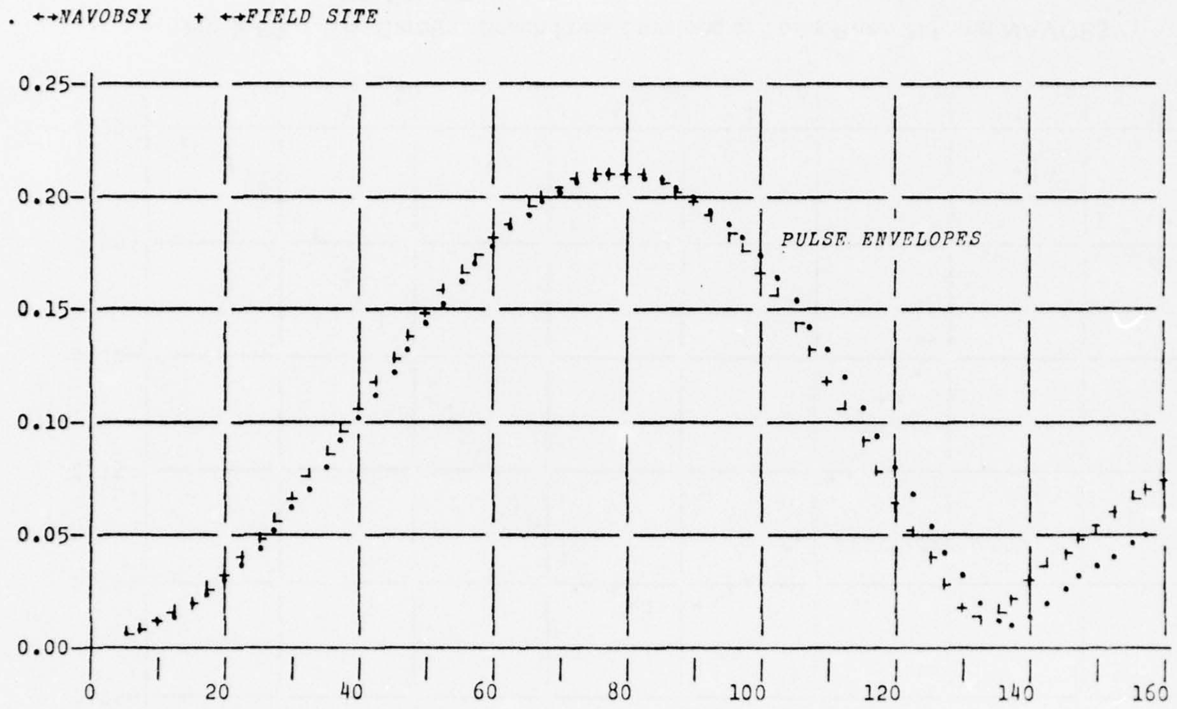
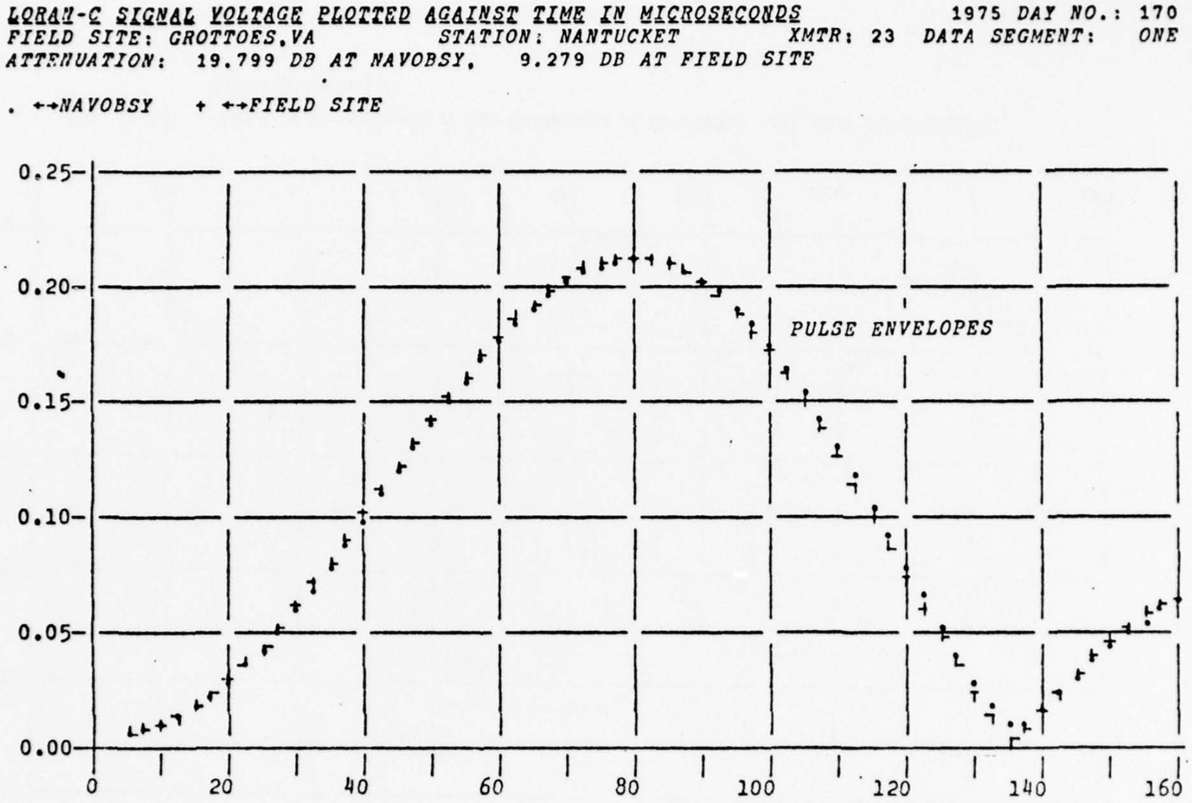


Fig. E-60 The Carolina Beach Pulse Envelope at Toms River, NJ, and NAVOBSY; Data Segment 3



LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 170
FIELD SITE: GROTTOES,VA STATION: NANTUCKET XMTR: 23 DATA SEGMENT: ONE
ATTENUATION: 19.799 DB AT NAVOBSY, 9.279 DB AT FIELD SITE

. ←→NAVOBSY + ←→FIELD SITE

Fig. E-61 The Carolina Beach Pulse Envelope at Grottoes, VA, and NAVOBSY; Data Segment 1

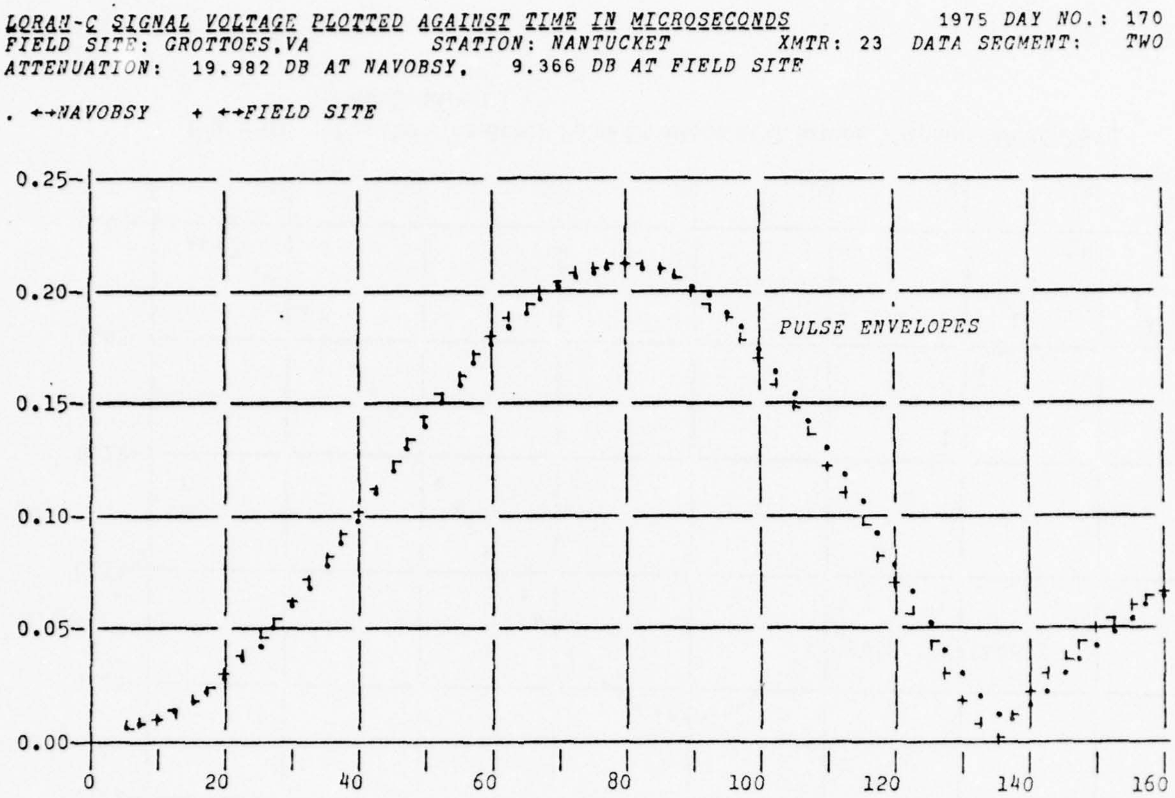


Fig. E-62 The Carolina Beach Pulse Envelope at Grottoes, VA, and NAVOBSY; Data Segment 2

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 170
FIELD SITE: GROTTOES,VA STATION: NANTUCKET XMTR: 23 DATA SEGMENT: THREE
ATTENUATION: 19.958 DB AT NAVOBSY, 9.271 DB AT FIELD SITE

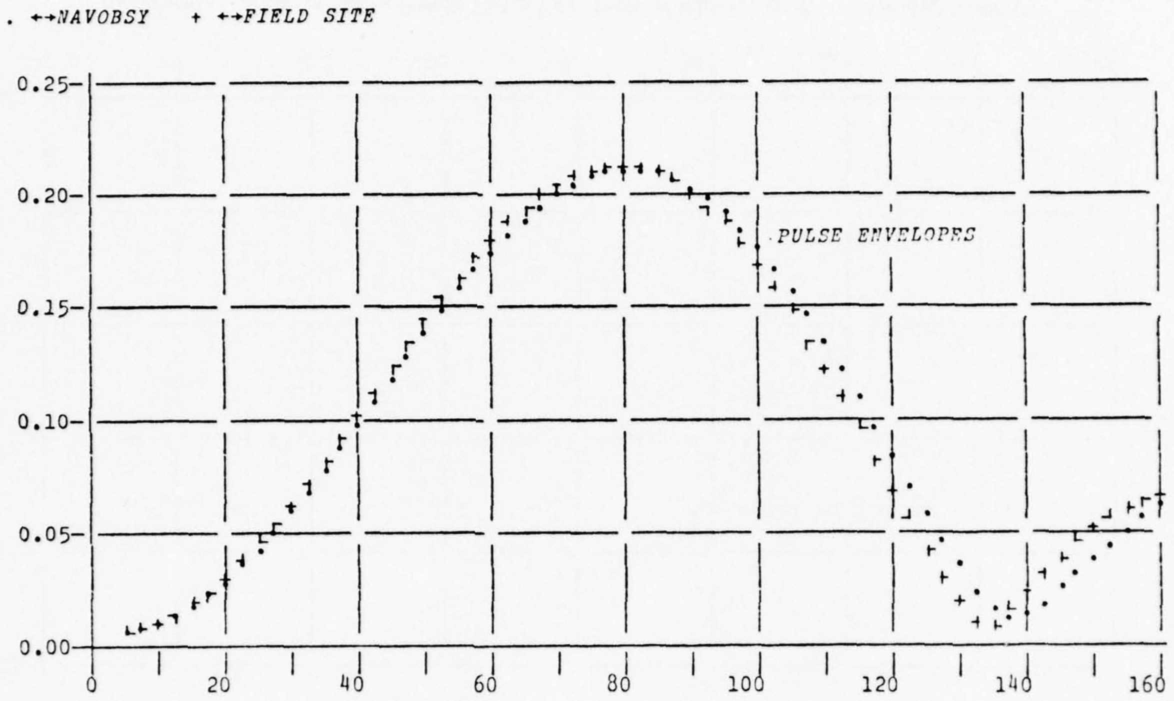


Fig. E-63 The Carolina Beach Pulse Envelope at Grottoes, VA, and NAVOBSY; Data Segment 3

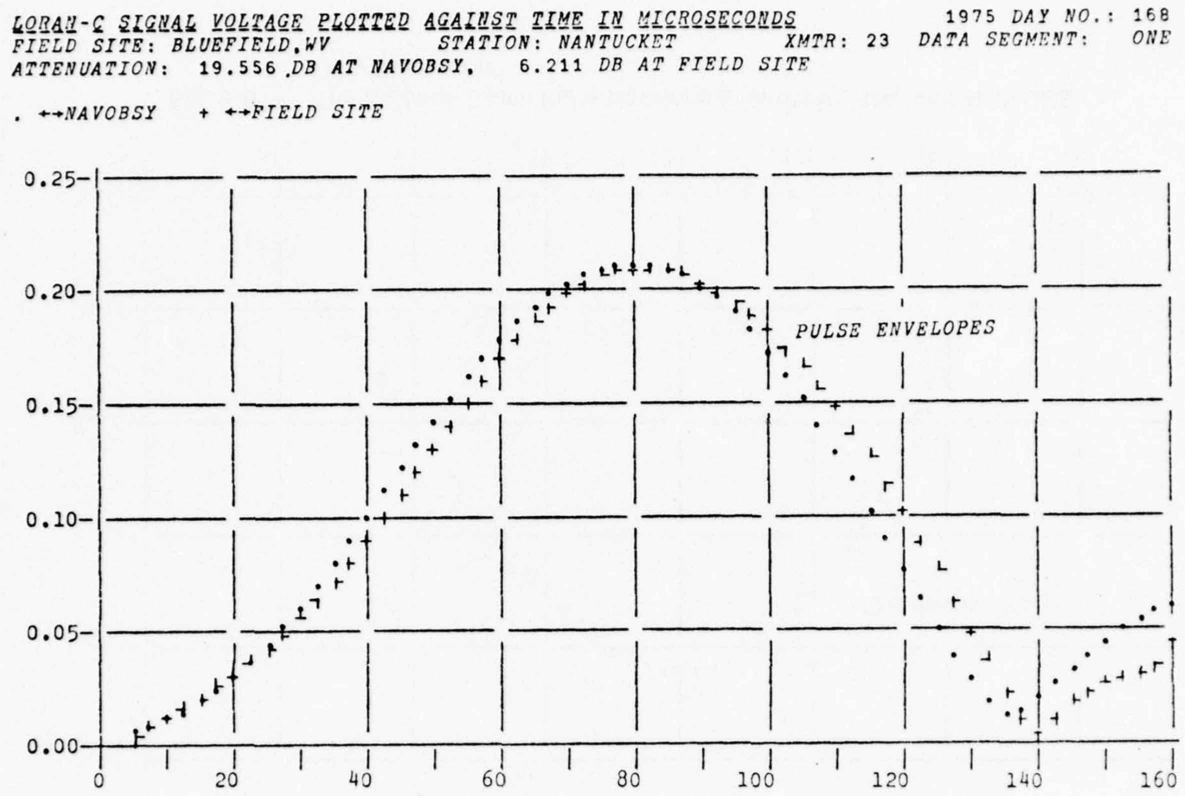

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 168
FIELD SITE: BLUEFIELD,WV STATION: NANTUCKET XMTR: 23 DATA SEGMENT: ONE
ATTENUATION: 19.556 DB AT NAVOBSY, 6.211 DB AT FIELD SITE

Fig. E-64 The Carolina Beach Pulse Envelope at Bluefield, WV, and NAVOBSY; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 168
FIELD SITE: BLUEFIELD,WV STATION: NANTUCKET XMTR: 23 DATA SEGMENT: TWO
ATTENUATION: 19.488 DB AT NAVOBSY, 6.112 DB AT FIELD SITE

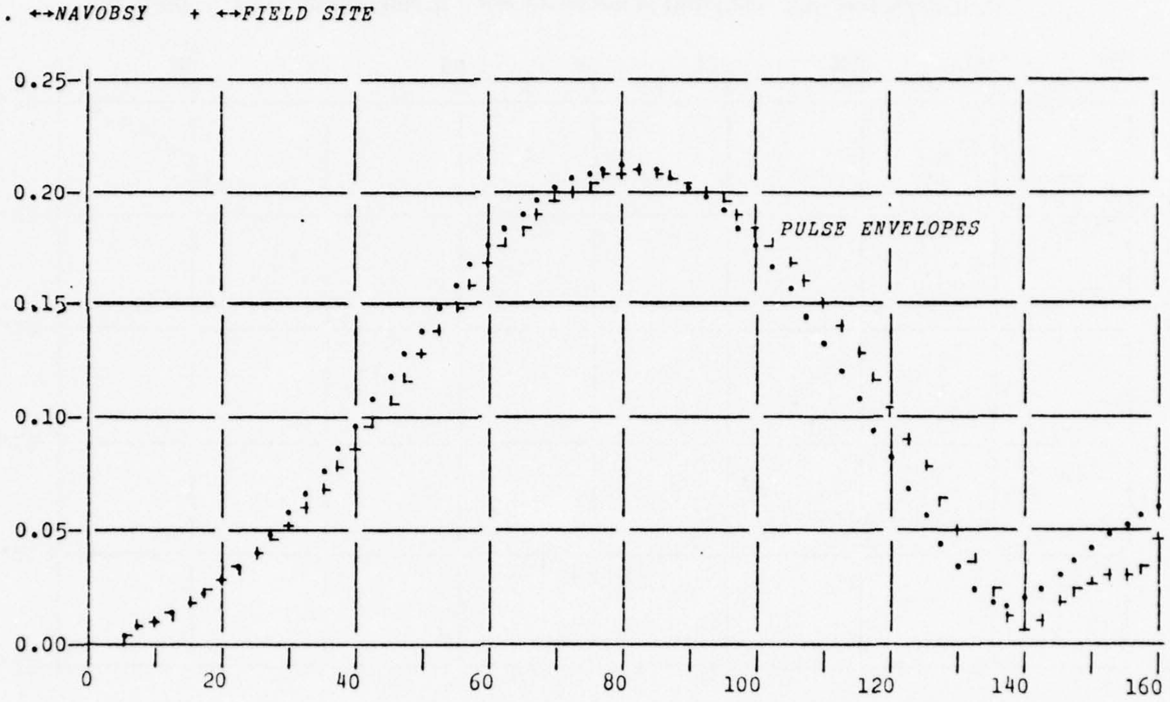


Fig. E-65 The Carolina Beach Pulse Envelope at Bluefield, WV, and NAVOBSY; Data Segment 2

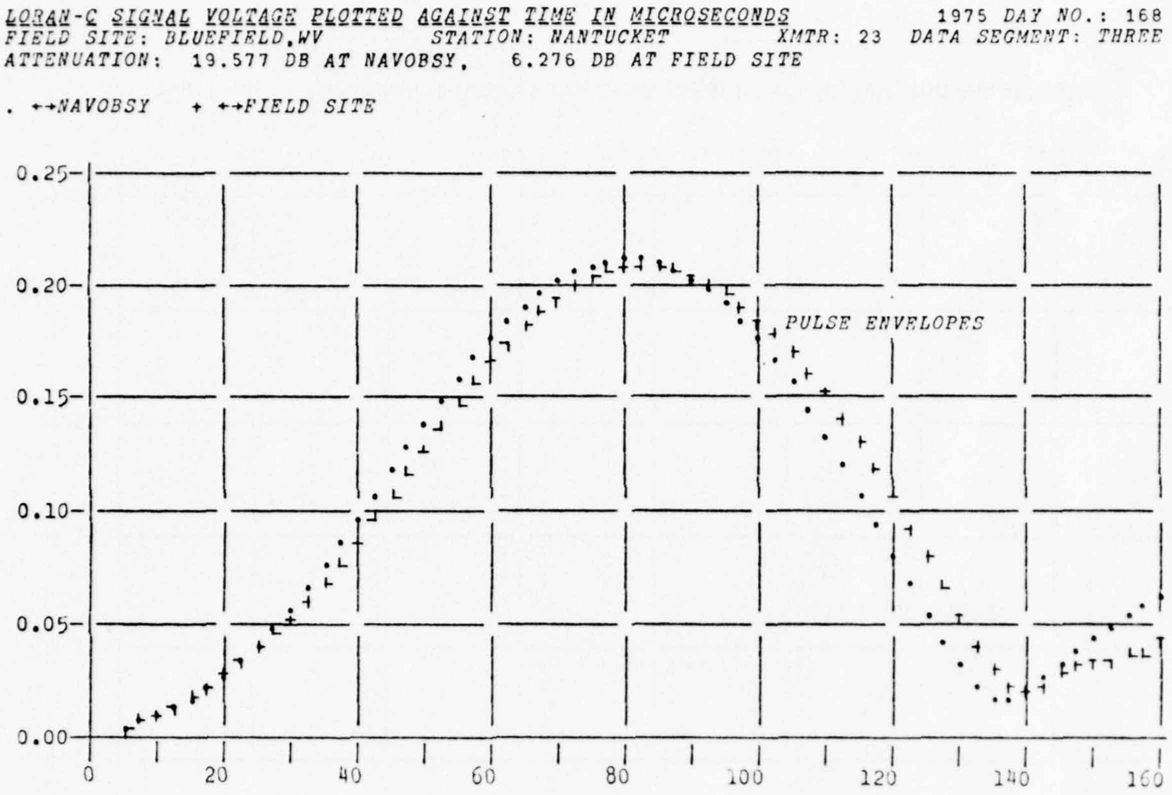


Fig. E-66 The Carolina Beach Pulse Envelope at Bluefield, WV, and NAVOBSY; Data Segment 3

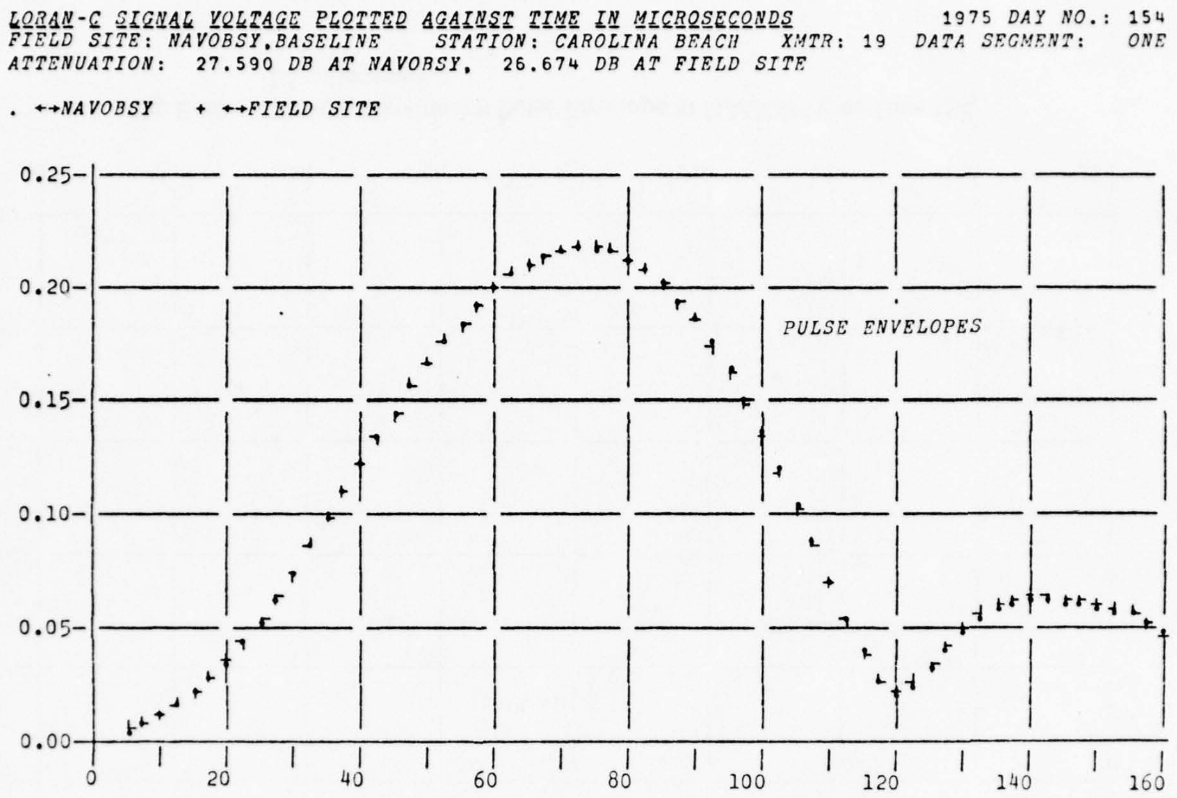


Fig. E-67 The Carolina Beach Pulse Envelope at NAVOBSY on Day 154; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 154
FIELD SITE: NAVOBSY,BASELINE STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 27.945 DB AT NAVOBSY, 27.046 DB AT FIELD SITE

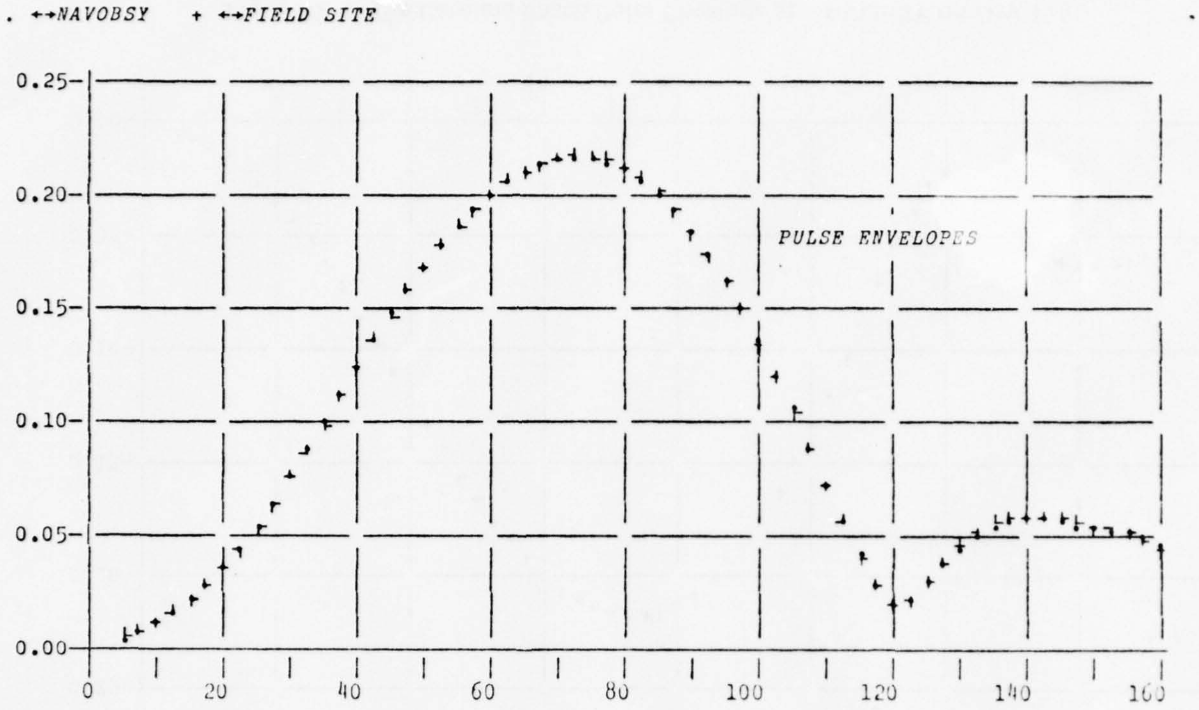


Fig. E-68 The Carolina Beach Pulse Envelope at NAVOBSY on Day 154; Data Segment 2

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS   1975 DAY NO.: 154
FIELD SITE: NAVOBSY,BASELINE   STATION: CAROLINA BEACH   XMTR: 19   DATA SEGMENT: THREE
ATTENUATION: 27.930 DB AT NAVOBSY, 27.004 DB AT FIELD SITE

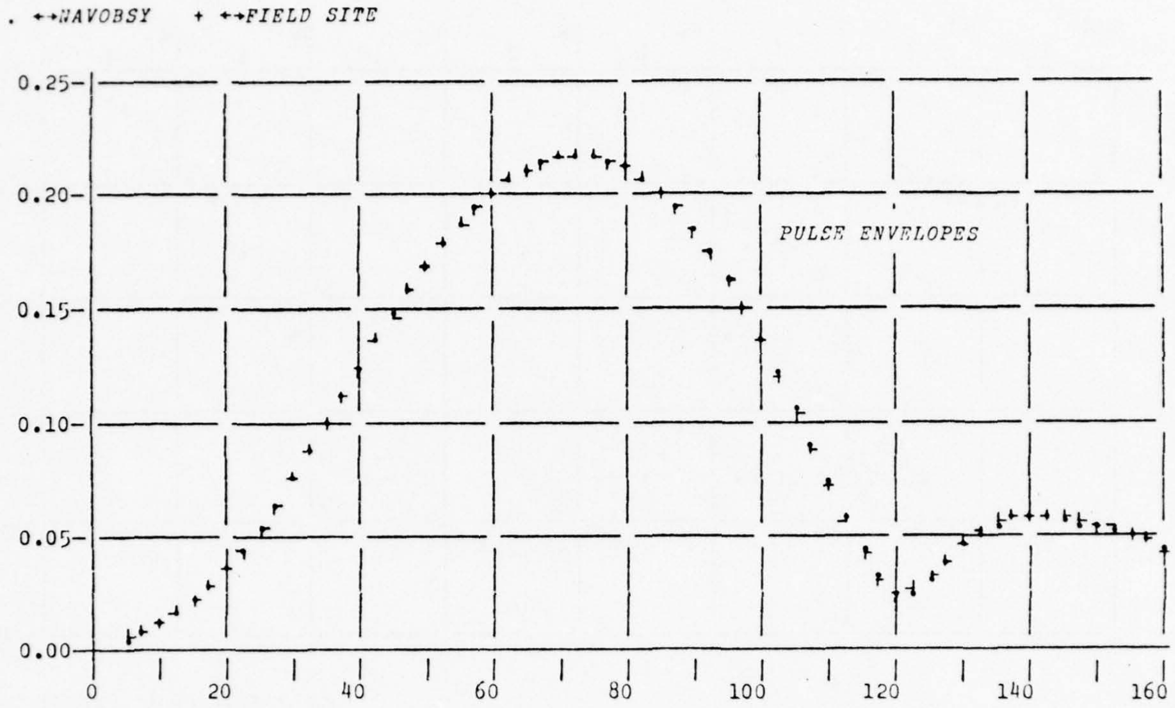


Fig. E-69 The Carolina Beach Pulse Envelope at NAVOBSY on Day 154; Data Segment 3

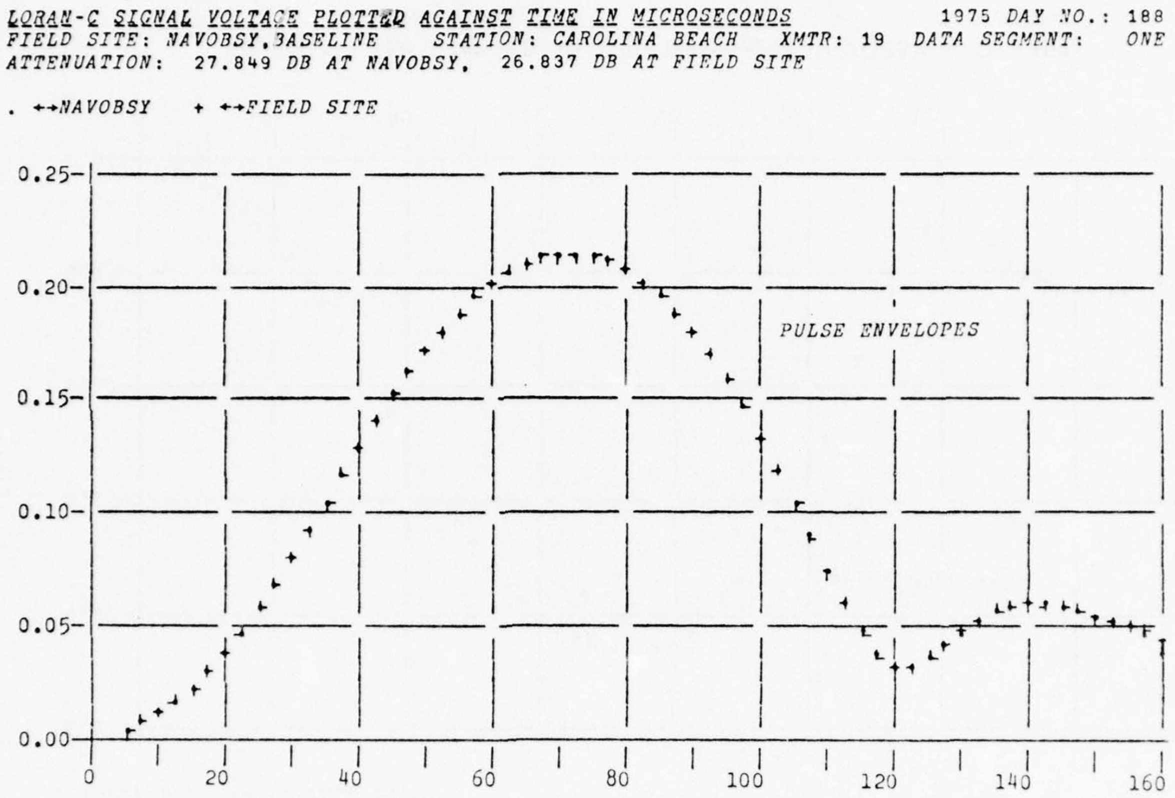


Fig. E-70 The Carolina Beach Pulse Envelope at NAVOBSY on Day 188; Data Segment 1

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 DAY NO.: 188
FIELD SITE: NAVOBSY,BASELINE STATION: CAROLINA BEACH XMTR: 19 DATA SEGMENT: TWO
ATTENUATION: 27.724 DB AT NAVOBSY, 26.772 DB AT FIELD SITE

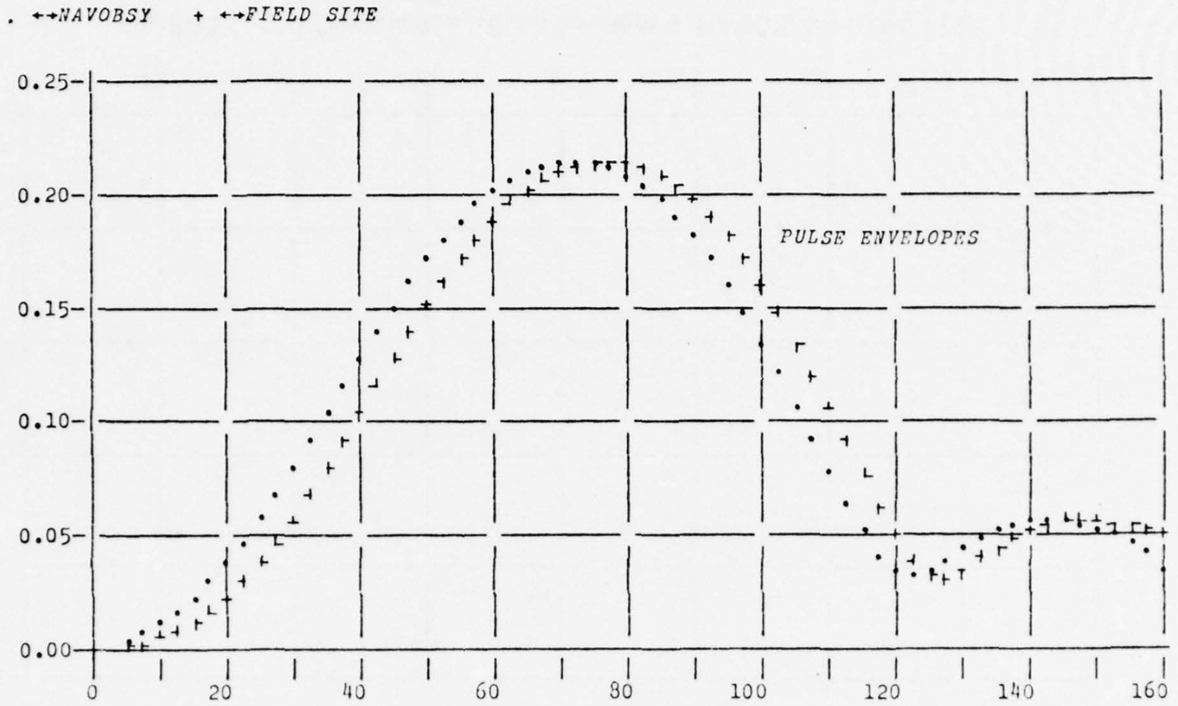


Fig. E-71 The Carolina Beach Pulse Envelope at NAVOBSY on Day 188; Data Segment 2

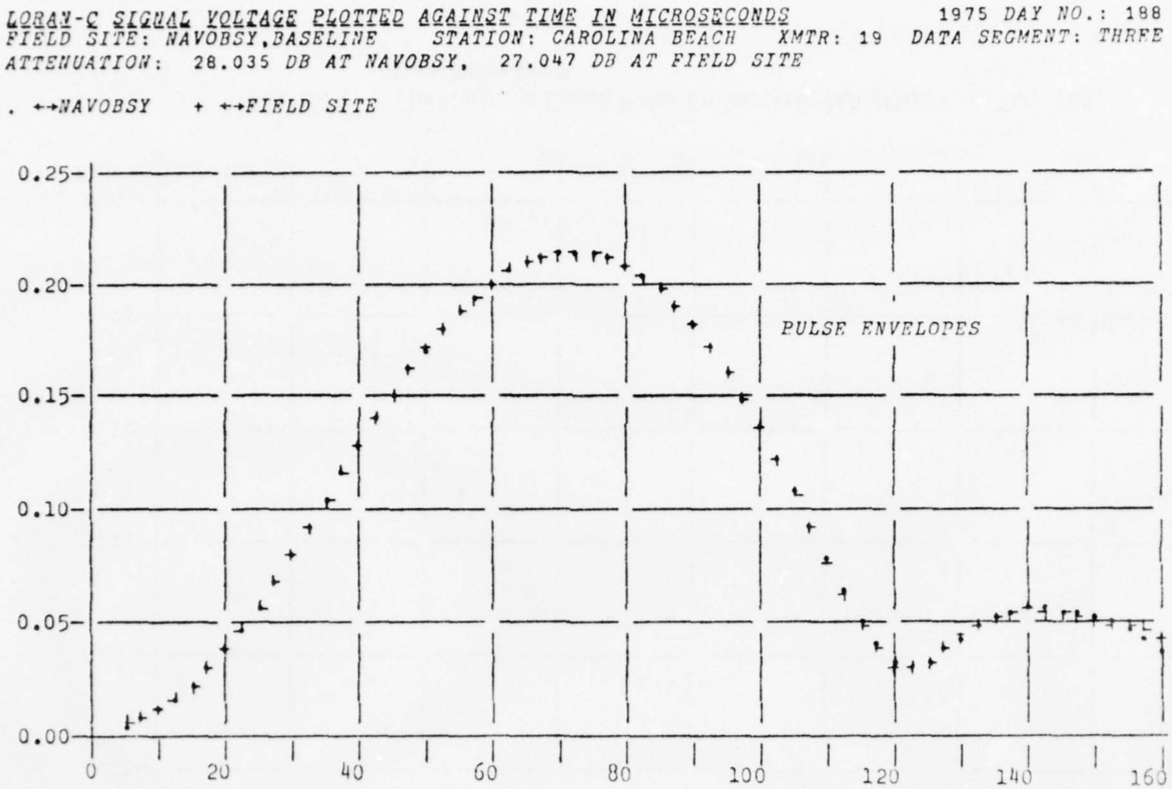


Fig. E-72 The Carolina Beach Pulse Envelope at NAVOBSY on Day 188; Data Segment 3

Table E-1

The Time of Zero Crossings Relative to the Time of the 11th Sample Point on the Pulse, NAVOBSY

	ZTO															
C1	5.706	10.574	15.447	20.338	25.249	30.171	35.102	40.039	44.979	49.922	54.869	59.823	64.785	69.757	74.742	79.740
	5.685	10.575	15.451	20.340	25.249	30.170	35.102	40.038	44.978	49.921	54.869	59.823	64.784	69.756	74.739	79.736
	5.702	10.562	15.440	20.335	25.248	30.170	35.102	40.039	44.978	49.921	54.869	59.823	64.785	69.756	74.740	79.737
C2	5.845	10.624	15.484	20.372	25.278	30.194	35.117	40.045	44.977	49.912	54.851	59.797	64.749	69.711	74.682	79.664
	5.829	10.591	15.458	20.352	25.260	30.175	35.097	40.024	44.954	49.888	54.828	59.773	64.726	69.688	74.660	79.641
	5.826	10.601	15.467	20.360	25.267	30.182	35.103	40.030	44.961	49.895	54.835	59.781	64.734	69.697	74.669	79.652
C3	6.028	10.799	15.590	20.424	25.297	30.198	35.116	40.047	44.984	49.927	54.876	59.832	64.796	69.770	74.753	79.747
	6.060	10.826	15.607	20.433	25.303	30.204	35.123	40.054	44.992	49.936	54.885	59.841	64.806	69.780	74.764	79.759
	6.022	10.799	15.590	20.422	25.295	30.195	35.115	40.045	44.983	49.927	54.876	59.832	64.796	69.769	74.752	79.745
C4	5.677	10.535	15.424	20.330	25.250	30.177	35.112	40.053	44.996	49.943	54.896	59.855	64.822	69.800	74.789	79.792
	5.618	10.567	15.444	20.333	25.246	30.176	35.116	40.061	45.009	49.958	54.911	59.869	64.834	69.809	74.795	79.795
	5.595	10.552	15.432	20.322	25.237	30.167	35.107	40.053	45.001	49.951	54.904	59.862	64.827	69.802	74.789	79.789
D1	6.321	10.426	15.205	20.113	25.069	30.047	35.036	40.030	45.026	50.023	55.018	60.012	65.004	69.994	74.982	79.965
	6.631	10.556	15.245	20.122	25.068	30.044	35.034	40.030	45.027	50.024	55.019	60.014	65.007	69.999	74.989	79.977
	6.454	10.462	15.224	20.121	25.073	30.050	35.040	40.036	45.033	50.030	55.025	60.018	65.009	69.998	74.984	79.968
D2	6.877	10.771	15.299	20.130	25.065	30.036	35.021	40.010	45.000	49.989	54.977	59.965	64.953	69.941	74.927	79.911
	6.841	10.758	15.292	20.126	25.064	30.038	35.025	40.015	45.006	49.995	54.983	59.970	64.957	69.943	74.928	79.911
	6.819	10.734	15.280	20.121	25.059	30.031	35.016	40.005	44.995	49.985	54.975	59.965	64.955	69.945	74.933	79.919
D3	6.582	10.283	15.032	19.963	24.942	29.938	34.937	39.936	44.931	49.924	54.914	59.902	64.889	69.874	74.857	79.837
	7.155	10.417	15.084	19.989	24.956	29.947	34.946	39.944	44.941	49.934	54.924	59.912	64.898	69.883	74.865	79.844
	7.149	10.352	15.050	19.969	24.945	29.940	34.940	39.939	44.935	49.926	54.915	59.902	64.886	69.869	74.850	79.827
N1	5.855	10.588	15.406	20.283	25.197	30.133	35.083	40.043	45.008	49.977	54.951	59.927	64.907	69.889	74.873	79.860
	6.056	10.753	15.496	20.318	25.208	30.142	35.099	40.067	45.038	50.010	54.982	59.956	64.933	69.914	74.900	79.890
	5.867	10.626	15.425	20.289	25.204	30.149	35.108	40.073	45.039	50.006	54.974	59.946	64.923	69.905	74.893	79.886
N2	5.720	10.496	15.314	20.191	25.109	30.052	35.010	39.975	44.946	49.921	54.900	59.883	64.869	69.858	74.850	79.844
	5.758	10.516	15.330	20.204	25.118	30.058	35.013	39.977	44.946	49.921	54.900	59.882	64.868	69.857	74.849	79.843
	5.864	10.547	15.329	20.193	25.108	30.053	35.013	39.980	44.951	49.926	54.904	59.885	64.870	69.859	74.852	79.847
N3	5.702	10.553	15.425	20.310	25.215	30.140	35.084	40.042	45.011	49.987	54.968	59.954	64.942	69.932	74.924	79.918
	5.645	10.508	15.385	20.280	25.194	30.131	35.085	40.053	45.030	50.013	55.001	59.992	64.985	69.980	74.976	79.974
	5.561	10.468	15.368	20.275	25.198	30.139	35.095	40.064	45.041	50.025	55.012	60.004	64.997	69.992	74.988	79.985
CC (Day 154)	5.849	10.602	15.463	20.351	25.253	30.163	35.083	40.010	44.941	49.878	54.821	59.770	64.726	69.691	74.666	79.651
	5.855	10.632	15.491	20.372	25.272	30.182	35.101	40.028	44.958	49.894	54.835	59.783	64.739	69.703	74.678	79.664
	5.840	10.633	15.494	20.374	25.273	30.182	35.101	40.026	44.956	49.890	54.830	59.777	64.732	69.696	74.671	79.657
CO (Day 188)	6.207	10.908	15.673	20.484	25.329	30.200	35.088	39.989	44.898	49.815	54.740	59.673	64.618	69.575	74.547	79.534
	6.207	10.908	15.669	20.477	25.320	30.189	35.076	39.976	44.884	49.801	54.726	59.660	64.604	69.562	74.534	79.522
	6.180	10.900	15.673	20.487	25.332	30.202	35.090	39.990	44.898	49.815	54.739	59.673	64.618	69.575	74.546	79.533

Table E-2
The Time of Zero Crossings Relative to the Time of the 11th Sample Point on the Pulse, Field Sites

	ZTV															
C1	5.831	10.613	15.454	20.327	25.227	30.142	35.069	40.004	44.945	49.891	54.842	59.800	64.765	69.740	74.725	79.722
	5.826	10.611	15.452	20.327	25.227	30.142	35.070	40.005	44.945	49.890	54.842	59.799	64.764	69.738	74.723	79.721
	5.823	10.607	15.450	20.326	25.226	30.142	35.069	40.005	44.945	49.891	54.842	59.800	64.765	69.739	74.724	79.722
C2	5.883	10.610	15.444	20.322	25.223	30.137	35.060	39.988	44.919	49.855	54.796	59.743	64.697	69.661	74.635	79.620
	5.863	10.589	15.424	20.303	25.204	30.117	35.039	39.966	44.896	49.830	54.770	59.715	64.669	69.632	74.605	79.589
	5.864	10.596	15.432	20.311	25.212	30.125	35.047	39.974	44.904	49.839	54.779	59.725	64.679	69.642	74.616	79.600
C3	5.484	10.375	15.247	20.148	25.083	30.035	34.993	39.953	44.910	49.867	54.822	59.779	64.740	69.706	74.679	79.660
	5.597	10.447	15.300	20.193	25.119	30.064	35.017	39.970	44.922	49.873	54.825	59.778	64.735	69.699	74.670	79.649
	5.610	10.417	15.264	20.159	25.090	30.040	34.996	39.953	44.908	49.863	54.816	59.772	64.730	69.694	74.664	79.640
C4	5.087	10.000	14.988	19.964	24.947	29.935	34.923	39.907	44.886	49.860	54.832	59.803	64.778	69.761	74.753	79.757
	5.036	10.000	14.986	19.966	24.951	29.939	34.926	39.908	44.886	49.859	54.832	59.806	64.785	69.773	74.772	79.783
	5.002	9.995	14.971	19.952	24.942	29.933	34.922	39.905	44.883	49.857	54.830	59.805	64.785	69.773	74.772	79.784
D1	6.030	10.609	15.327	20.153	25.053	29.994	34.957	39.931	44.911	49.893	54.876	59.858	64.841	69.824	74.805	79.785
	6.046	10.618	15.333	20.158	25.056	29.998	34.960	39.934	44.914	49.895	54.878	59.860	64.843	69.825	74.807	79.786
	6.043	10.616	15.334	20.160	25.059	30.000	34.962	39.936	44.915	49.897	54.879	59.861	64.843	69.826	74.807	79.786
D2	5.756	10.579	15.350	20.191	25.094	30.036	34.999	39.972	44.952	49.933	54.916	59.898	64.879	69.858	74.836	79.809
	5.748	10.587	15.362	20.202	25.103	30.044	35.007	39.980	44.959	49.941	54.922	59.904	64.884	69.863	74.840	79.814
	5.783	10.584	15.352	20.193	25.096	30.037	34.999	39.972	44.951	49.933	54.915	59.897	64.878	69.857	74.834	79.807
D3	5.390	10.051	14.877	19.811	24.792	29.787	34.783	39.775	44.762	49.744	54.723	59.699	64.675	69.649	74.621	79.589
	5.428	10.119	14.925	19.841	24.811	29.799	34.792	39.780	44.764	49.741	54.715	59.686	64.655	69.622	74.587	79.547
	5.324	10.088	14.912	19.833	24.803	29.791	34.783	39.771	44.753	49.730	54.702	59.671	64.638	69.603	74.566	79.524
N1	5.893	10.612	15.404	20.264	25.168	30.100	35.049	40.007	44.971	49.941	54.914	59.891	64.873	69.858	74.848	79.840
	5.908	10.623	15.423	20.288	25.195	30.127	35.075	40.032	44.995	49.963	54.935	59.912	64.894	69.880	74.870	79.864
	5.909	10.620	15.419	20.285	25.192	30.124	35.072	40.029	44.991	49.959	54.931	59.908	64.889	69.875	74.865	79.859
N2	5.199	10.078	14.975	19.917	24.889	29.876	34.868	39.862	44.856	49.850	54.843	59.837	64.832	69.828	74.825	79.824
	5.251	10.130	15.010	19.939	24.904	29.887	34.878	39.871	44.863	49.855	54.845	59.836	64.827	69.820	74.814	79.810
	5.265	10.132	15.020	19.954	24.919	29.900	34.888	39.879	44.870	49.862	54.855	59.848	64.843	69.841	74.840	79.841
N3	4.435	9.913	15.138	20.212	25.192	30.126	35.048	39.979	44.927	49.893	54.873	59.862	64.854	69.846	74.834	79.817
	4.148	9.785	15.068	20.171	25.171	30.120	35.055	39.996	44.952	49.924	54.908	59.900	64.894	69.887	74.876	79.859
	4.297	9.834	15.090	20.186	25.185	30.136	35.073	40.014	44.968	49.935	54.913	59.896	64.880	69.861	74.837	79.805
CO (Day 154)	5.749	10.522	15.382	20.277	25.190	30.114	35.046	39.982	44.922	49.865	54.813	59.766	64.726	69.693	74.670	79.657
	5.664	10.454	15.313	20.205	25.118	30.043	34.975	39.910	44.849	49.791	54.737	59.688	64.647	69.614	74.591	79.579
	5.629	10.446	15.318	20.215	25.127	30.050	34.980	39.914	44.852	49.794	54.740	59.691	64.650	69.618	74.595	79.584
CO (Day 188)	6.122	10.834	15.614	20.442	25.303	30.188	35.087	39.997	44.912	49.834	54.763	59.700	64.647	69.608	74.583	79.573
	6.435	10.976	15.707	20.494	25.321	30.183	35.069	39.969	44.878	49.794	54.716	59.644	64.580	69.528	74.489	79.465
	6.100	10.826	15.615	20.446	25.308	30.192	35.092	40.001	44.917	49.839	54.768	59.704	64.652	69.612	74.586	79.575

Table E-3

Key to Labels That Denote the Location of the Instrumented Van

C0	NAVOBSY
C1	Wilmington, NC
C2	Emporia, VA
C3	Towanda, PA
C4	Dexter, NY
D0	NAVOBSY
D1	Danville, IN
D2	Marietta, OH
D3	Georgetown, DE
N0	NAVOBSY
N1	Toms River, NJ
N2	Grottoes, VA
N3	Bluefield, WV

Appendix F

RESULTS OF PULSE ALIGNMENT

This appendix assembles the illustrative material associated with pulse alignment at the 11th sample point on the pulse, i.e., nominally 30 μs from the start of the pulses. Figures F-1 through F-12 present the leading edges of pulses so aligned. The voltages plotted in these figures result from evaluations of the polynomials of Tables D-9 through D-12 and normalized to a peak value of 1.

From these values of voltage, ECM was calculated as explained in the main body of text. The result of this calculation is plotted against SPM in Fig. F-13. SPM and ECM are plotted against SPM in Fig. F-13. SPM and ECM are plotted against the distance from NAVOBSY to the field site in Figs. F-14 and F-15. Figure F-16 presents the observed attenuation of the signal at each site relative to the field strength of Carolina Beach observed at Wilmington, NC. Tables F-1 and F-2 tabulate the times of zero crossings relative to the time of the 11th sample point. The vertical groups of three rows are for the three data segments. Table F-3 records the values of the distance from the transmitting station to the site, ECM and SPM plotted in Figs. F-13, F-14, and F-15. Table F-4 records the values of attenuation plotted in Fig. F-16. The labels C1, C2 ... N0 in these tables refer to the location of the van during data recordings (see Table E-3 of Appendix E).

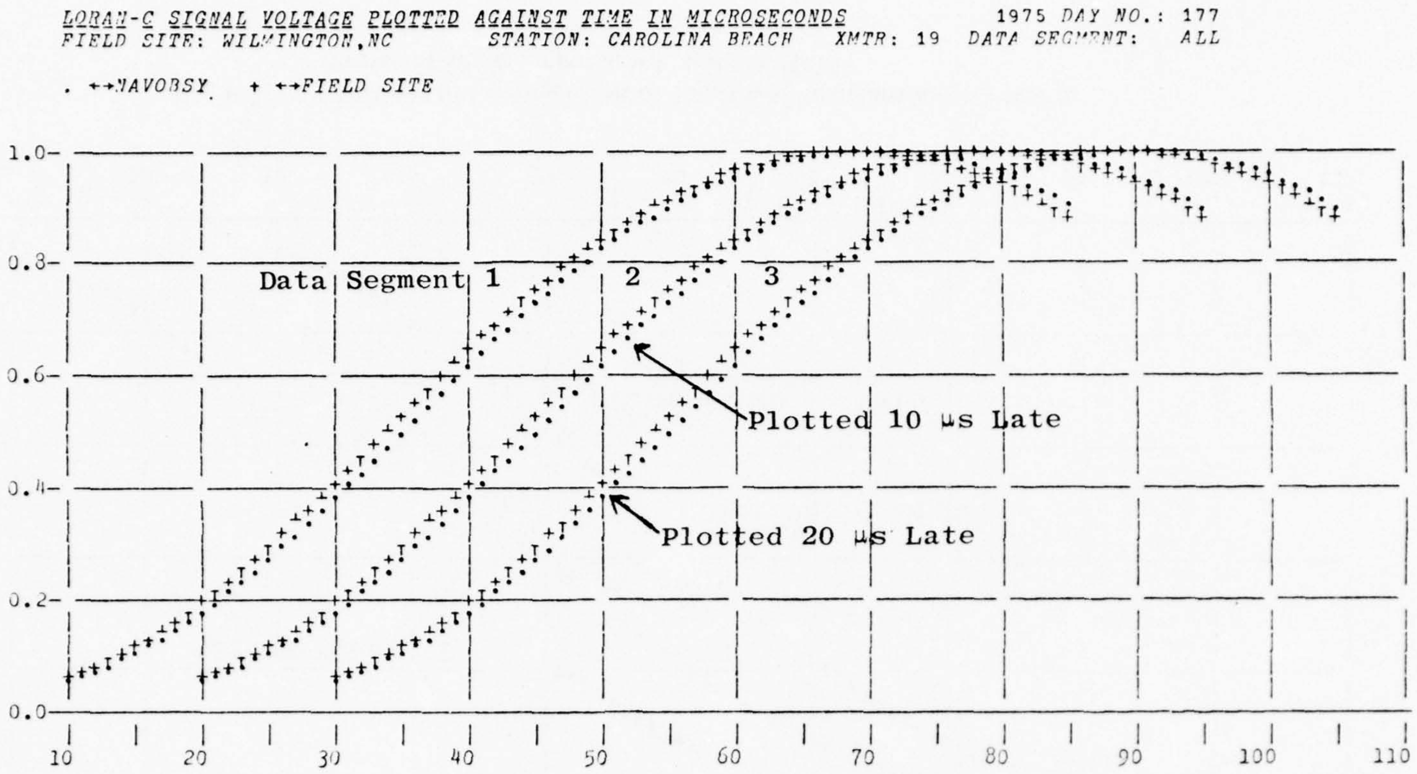


Fig. F-1 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 µs; Wilmington, NC, and NAVOBSY

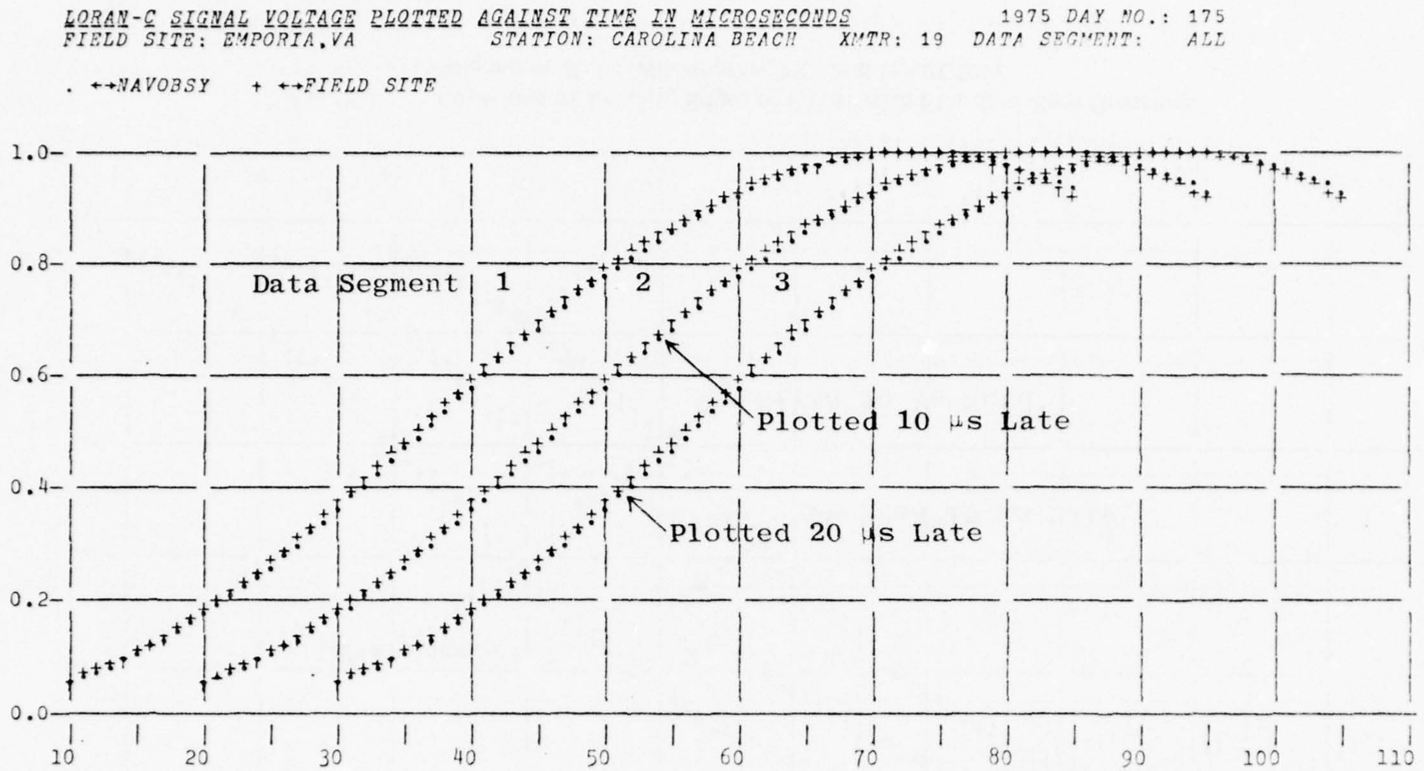


Fig. F-2 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Emporia, VA, and NAVOBSY

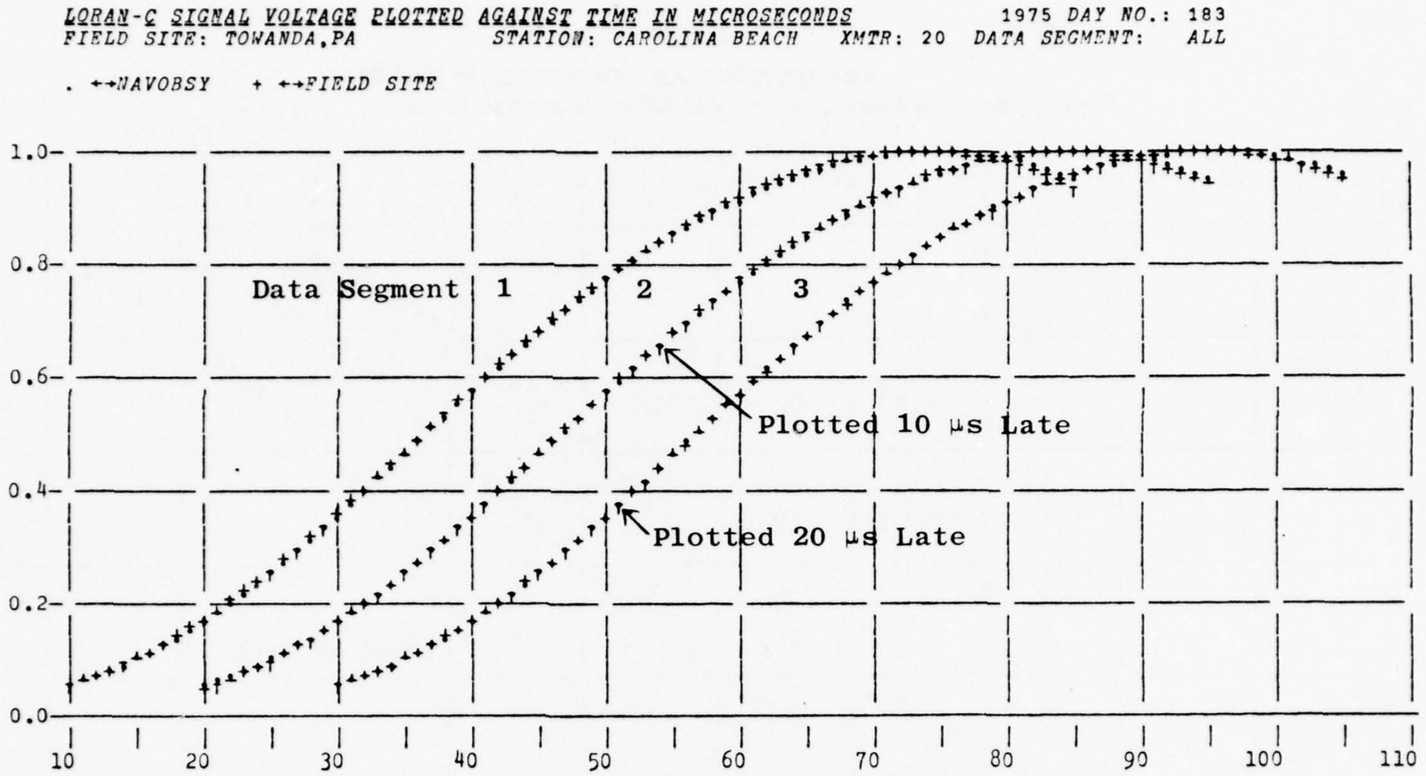


Fig. F-3 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Towanda, PA, and NAVOBSY

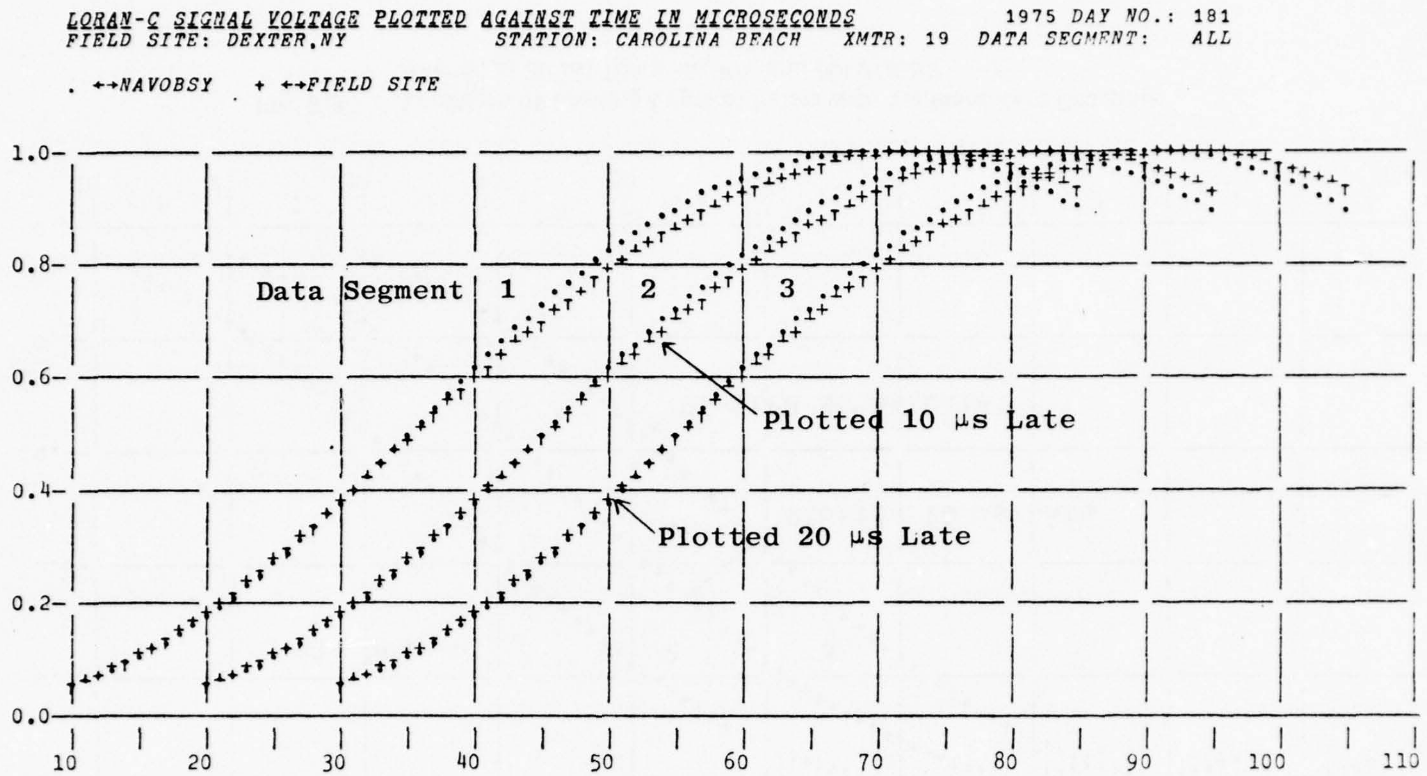


Fig. F-4 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Dexter, NY, and NAVOBSY

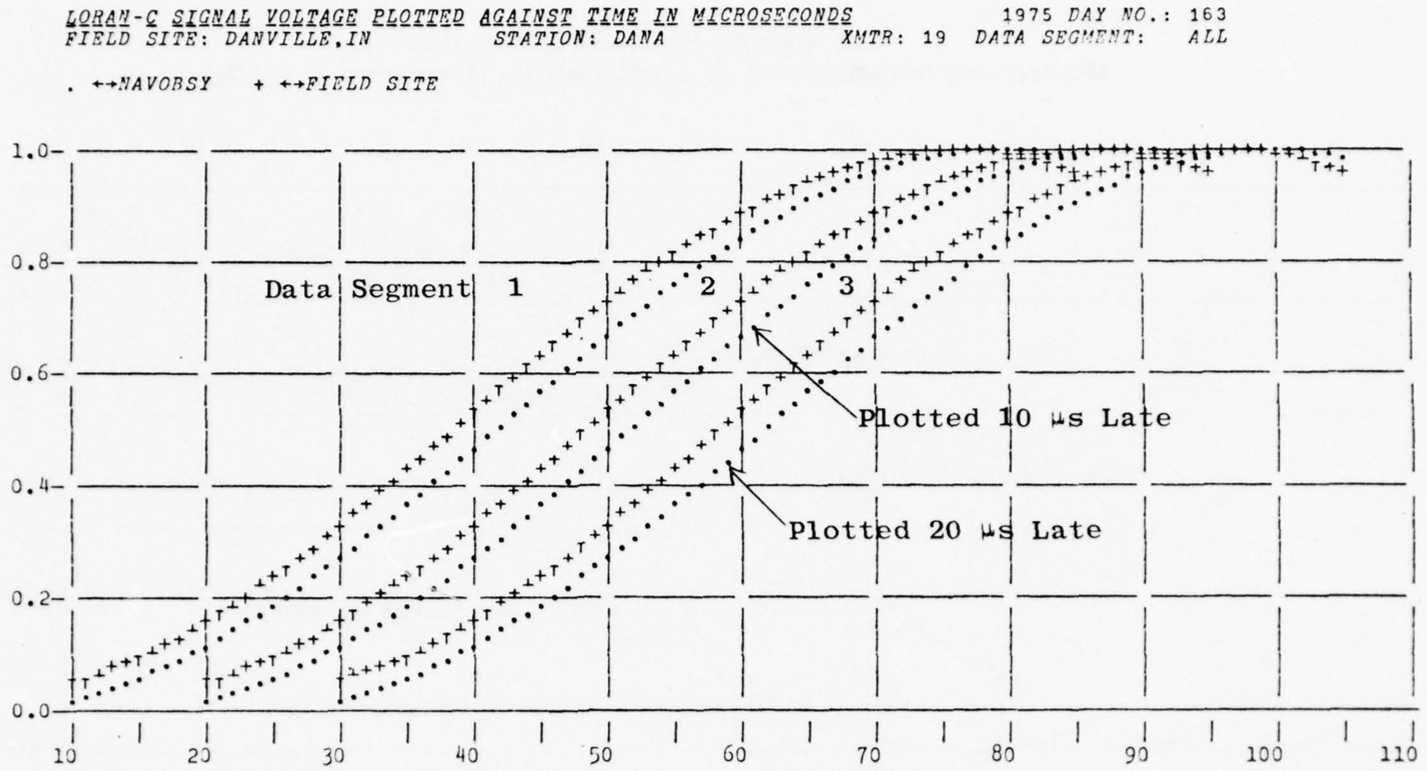


Fig. F-5 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Danville, IN, and NAVOBSY

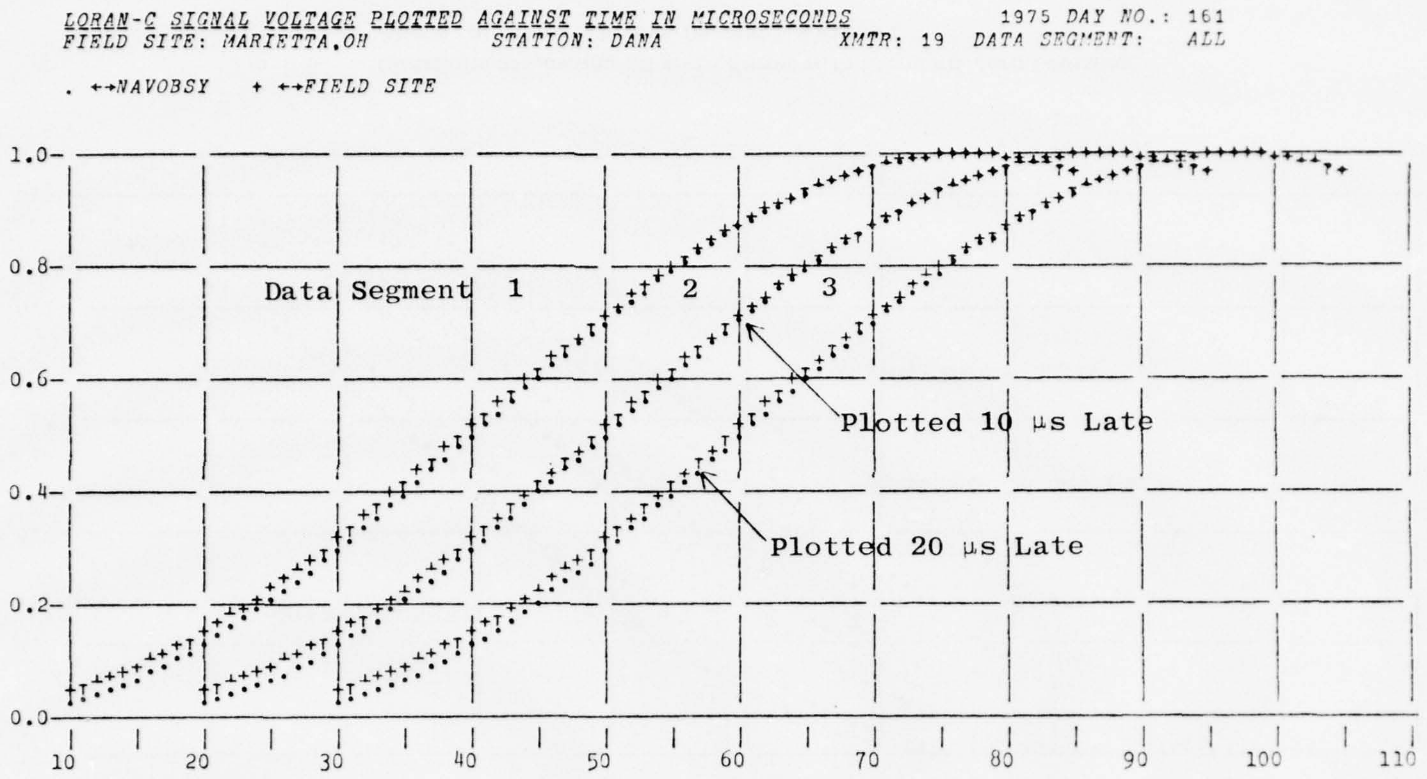


Fig. F-6 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Marietta, OH, and NAVOBSY

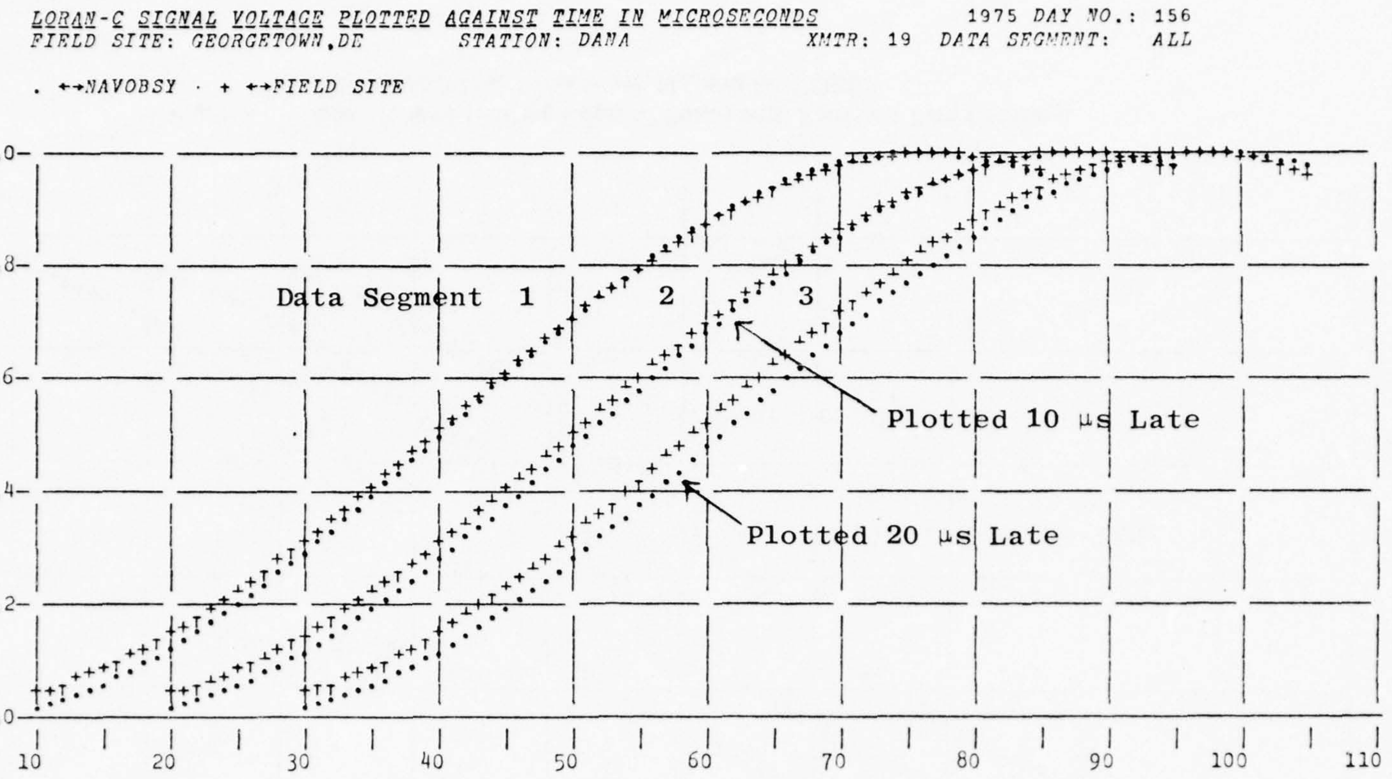


Fig. F-7 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Georgetown, DE, and NAVOBSY

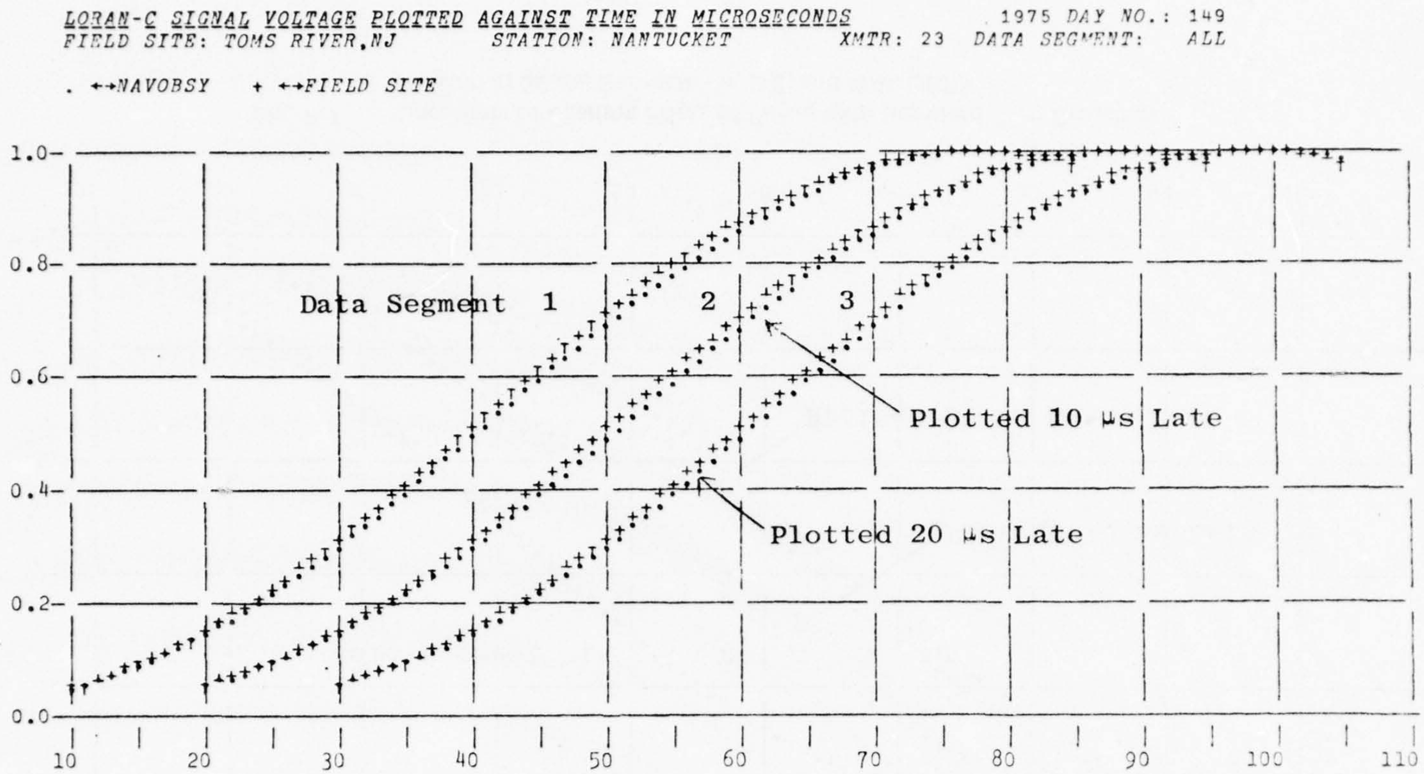


Fig. F-8 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Toms River, NJ, and NAVOBSY

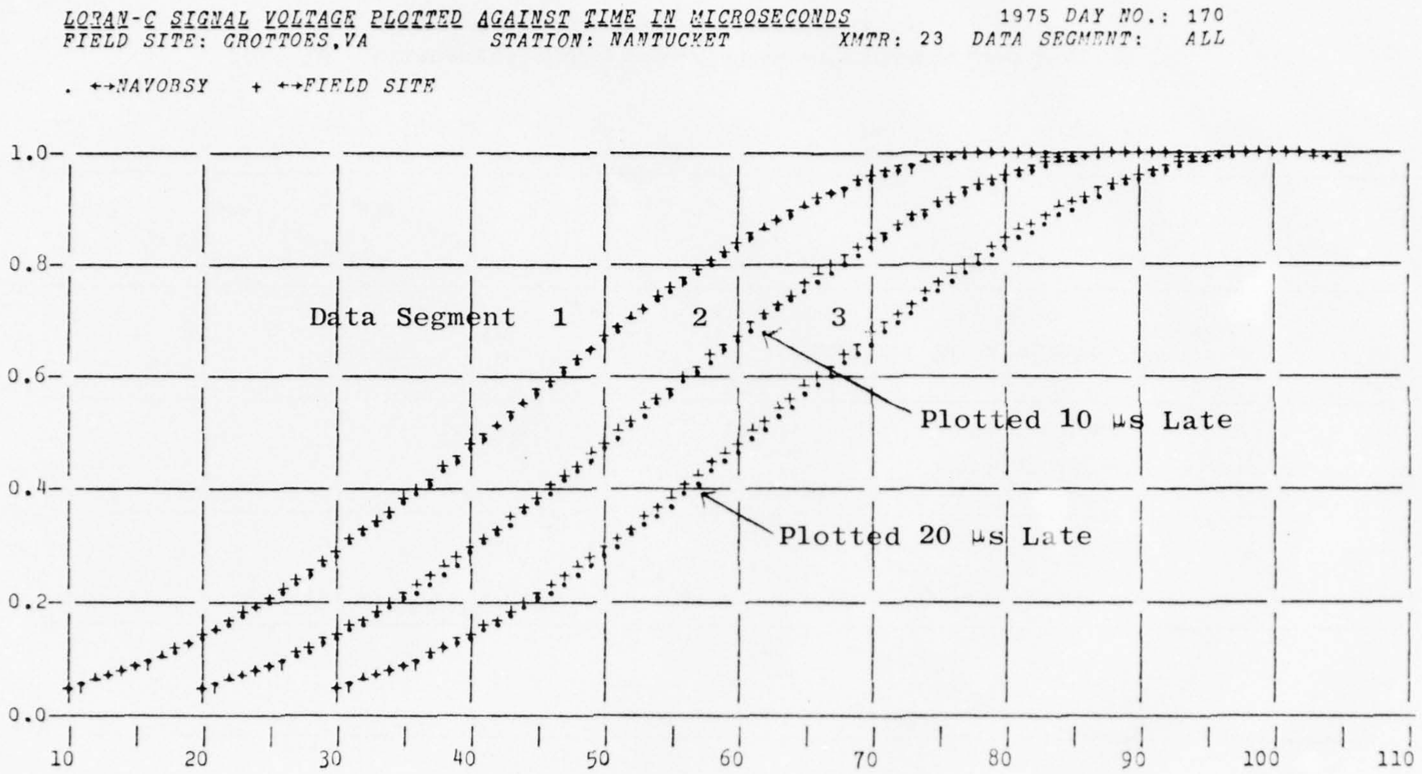


Fig. F-9 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Grottoes, VA, and NAVOBSY

LORAN-C SIGNAL VOLTAGE PLOTTED AGAINST TIME IN MICROSECONDS 1975 *DAY NO.:* 168
FIELD SITE: BLUEFIELD,WV *STATION: NANTUCKET* *XMTR:* 23 *DATA SEGMENT:* *ALL*

. ←→*NAVOBSY* + ←→*FIELD SITE*

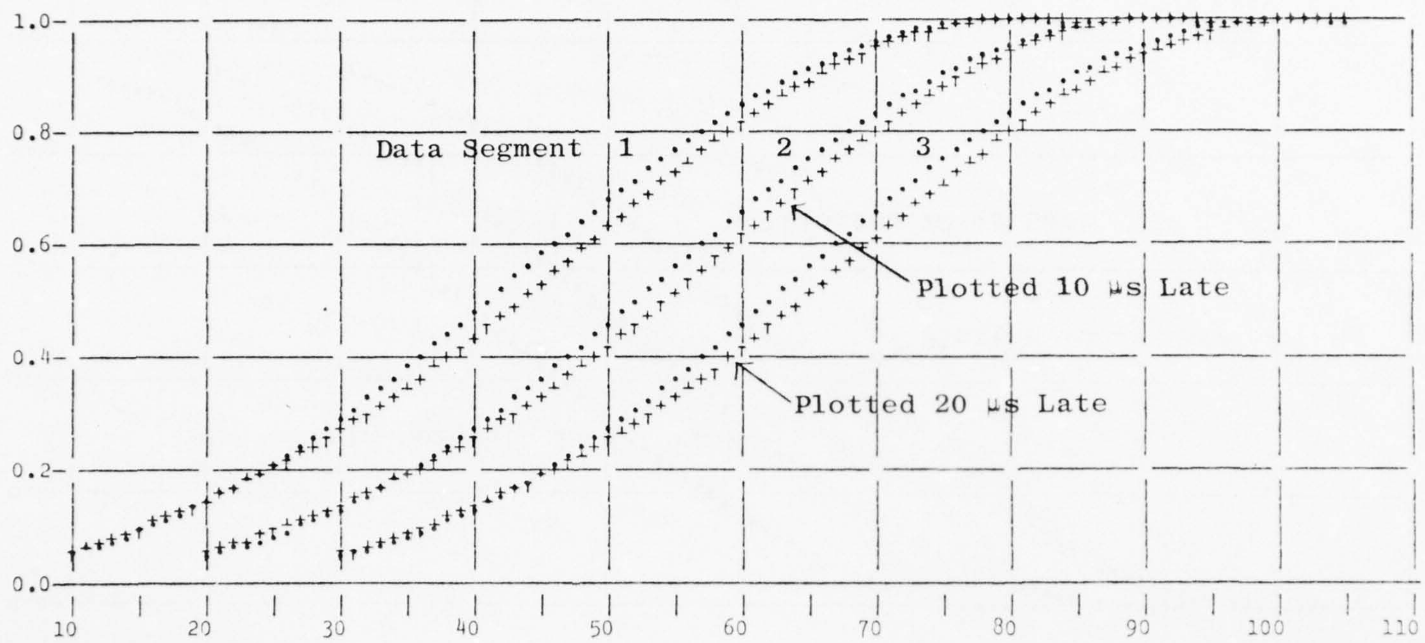


Fig. F-10 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; Bluefield, WV, and NAVOBSY

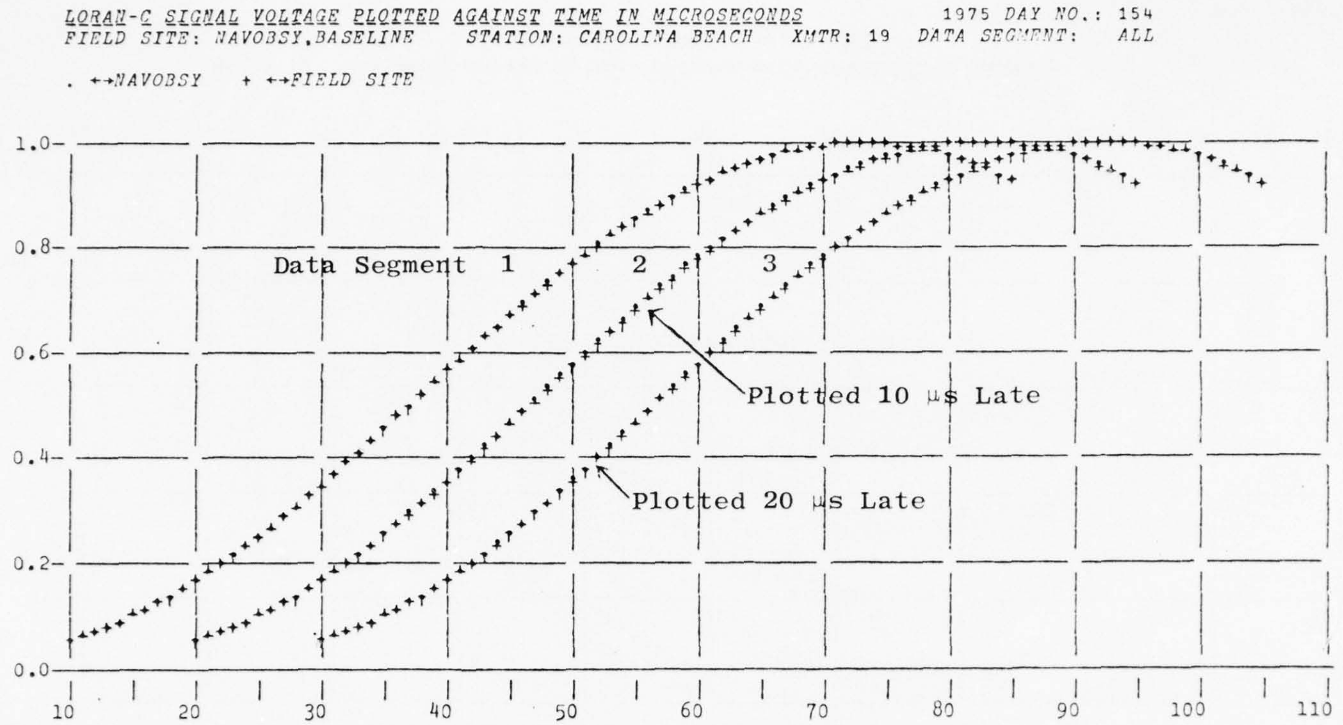


Fig. F-11 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; NAVOBSY, 1975 Day No. 154

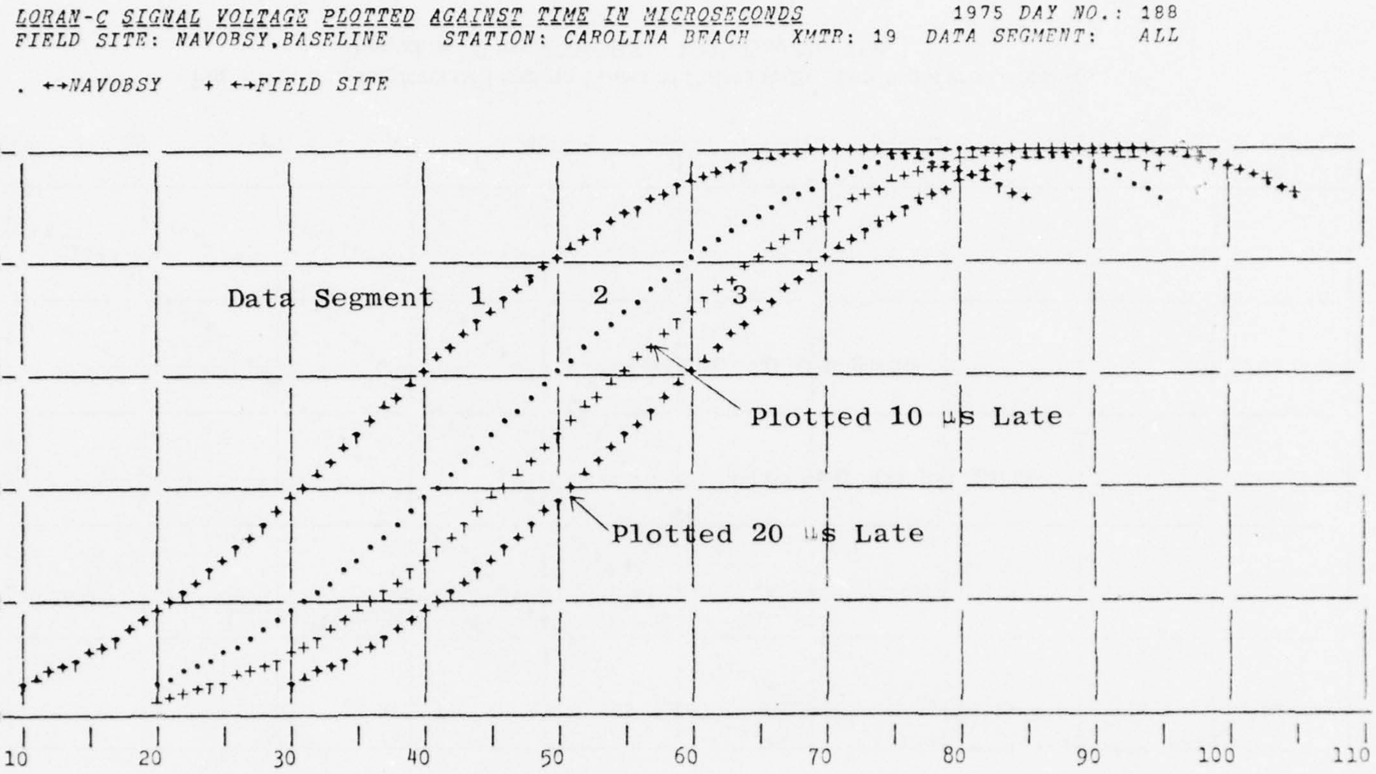
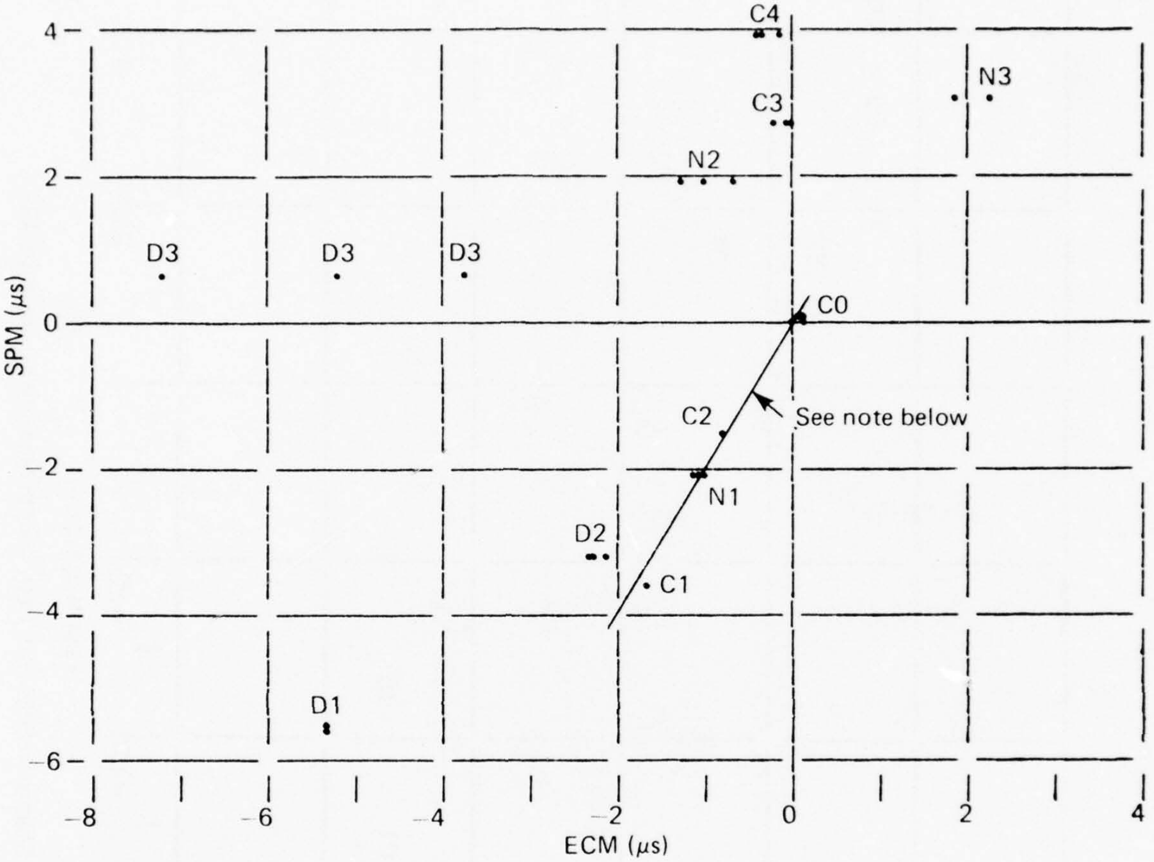


Fig. F-12 Locations of Leading Edges of Pulses with Standard Zero Crossings Aligned at 30 μs; NAVOBSY, 1975 Day No. 188



Note: The straight line is drawn through points for which both the field site and NAVOBSY are close to the inverse distance line in Fig. F-16.

Fig. F-13 The Relationship Between SPM and ECM

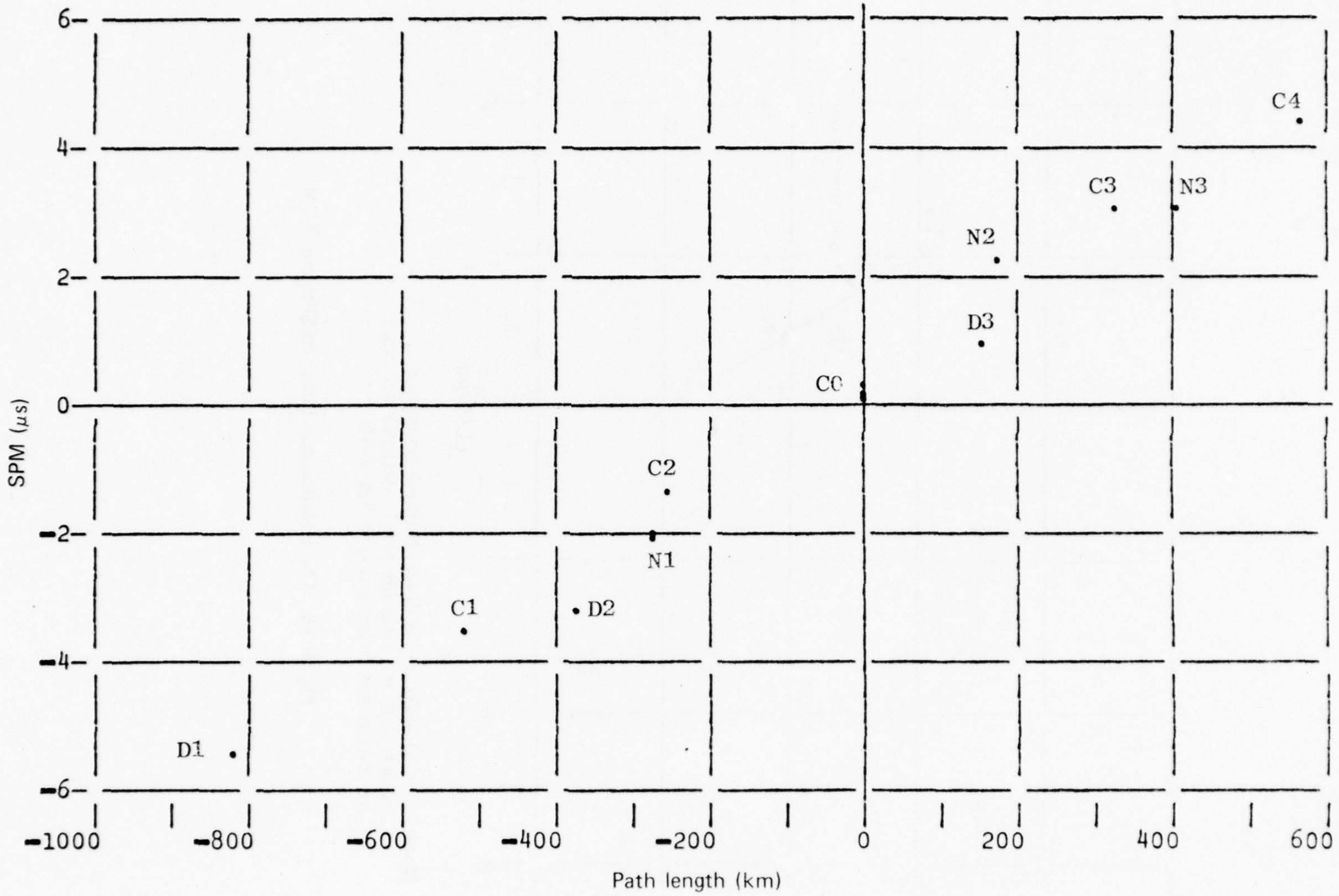


Fig. F-14 The Change in SPM with Path Length Measured from NAVOBSY

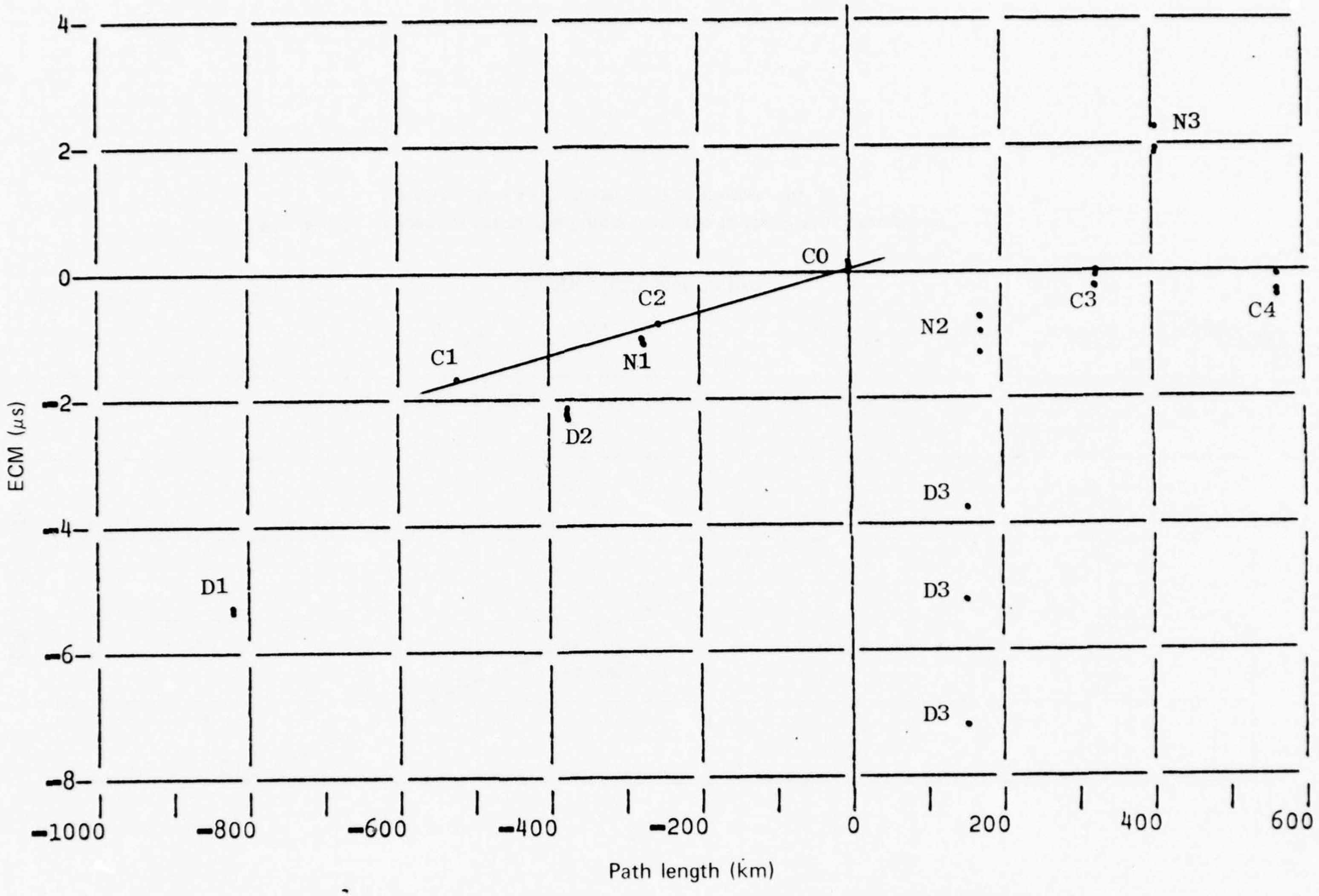


Fig. F-15 The Change in ECM with Path Length Measured from NAVOBSY

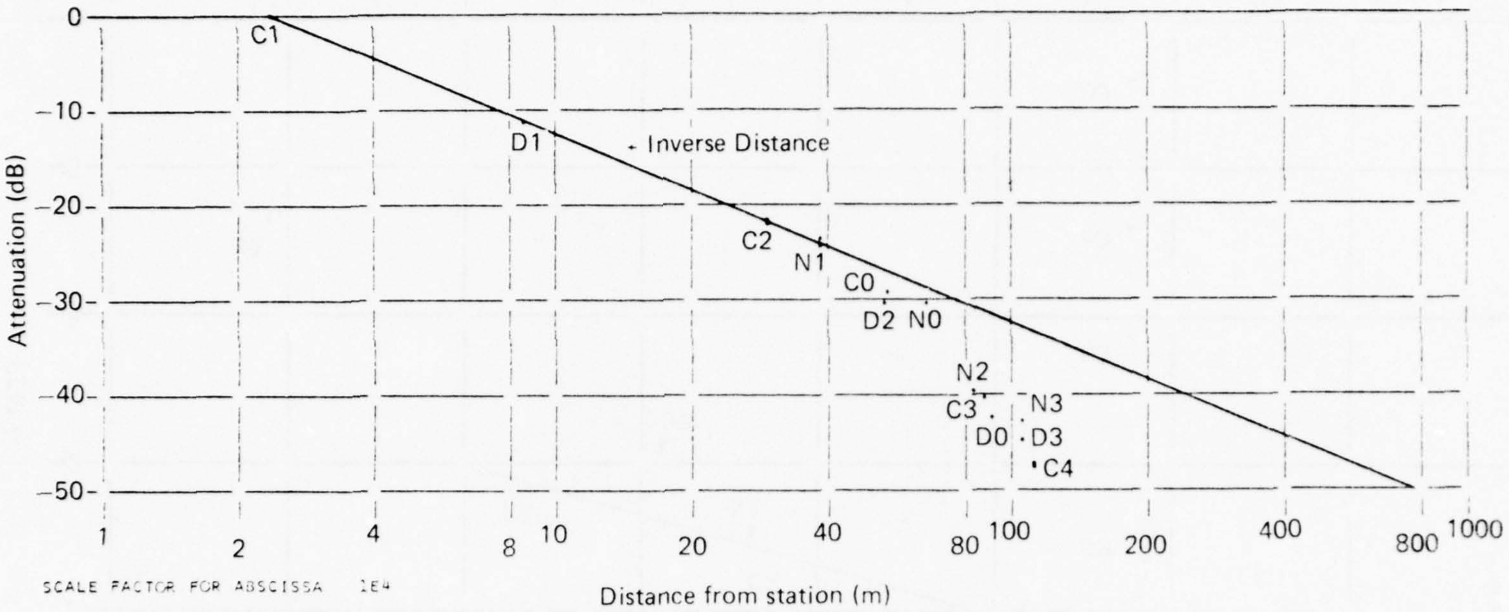


Fig. F-16 Attenuation of the Signal Relative to the Field Strength of Carolina Beach Observed at Wilmington, NC

Table F-1

The Time of Zero Crossings Relative to the Time of the 11th Sample Point on the Pulse, NAVOBSY

	ZT03															
C1	5.536	10.403	15.277	20.167	25.077	30.001	34.932	39.868	44.808	49.751	54.699	59.652	64.614	69.587	74.571	79.570
	5.517	10.404	15.281	20.170	25.078	30.001	34.931	39.868	44.808	49.751	54.699	59.652	64.614	69.586	74.569	79.566
	5.532	10.391	15.271	20.165	25.077	30.001	34.931	39.868	44.808	49.751	54.699	59.652	64.614	69.586	74.570	79.567
C2	5.651	10.430	15.290	20.178	25.084	30.001	34.923	39.851	44.783	49.718	54.657	59.603	64.555	69.517	74.488	79.470
	5.654	10.416	15.284	20.177	25.084	30.001	34.922	39.848	44.779	49.713	54.653	59.598	64.552	69.513	74.485	79.466
	5.644	10.419	15.286	20.178	25.085	30.001	34.922	39.849	44.780	49.714	54.654	59.599	64.553	69.515	74.488	79.470
C3	5.829	10.601	15.393	20.227	25.099	30.001	34.919	39.849	44.786	49.729	54.678	59.634	64.599	69.572	74.556	79.549
	5.856	10.622	15.403	20.230	25.099	30.001	34.919	39.851	44.789	49.732	54.681	59.638	64.602	69.576	74.561	79.555
	5.825	10.603	15.395	20.228	25.099	30.001	34.919	39.850	44.788	49.731	54.680	59.636	64.600	69.574	74.557	79.550
C4	5.502	10.357	15.249	20.153	25.072	30.001	34.935	39.875	44.819	49.767	54.719	59.677	64.645	69.622	74.612	79.615
	5.443	10.391	15.269	20.157	25.070	30.001	34.940	39.885	44.833	49.783	54.735	59.693	64.658	69.633	74.619	79.619
	5.429	10.384	15.266	20.155	25.070	30.001	34.941	39.886	44.834	49.784	54.737	59.695	64.660	69.635	74.622	79.623
D1	6.277	10.378	15.157	20.066	25.022	30.001	34.989	39.983	44.979	49.975	54.971	59.965	64.957	69.947	74.934	79.918
	6.588	10.514	15.200	20.078	25.024	30.001	34.990	39.986	44.983	49.980	54.975	59.970	64.963	69.955	74.945	79.933
	6.401	10.410	15.173	20.072	25.023	30.001	34.991	39.986	44.983	49.980	54.975	59.967	64.958	69.948	74.934	79.918
D2	6.841	10.735	15.263	20.094	25.029	30.000	34.985	39.974	44.963	49.952	54.941	59.929	64.917	69.905	74.891	79.875
	6.804	10.719	15.255	20.088	25.026	30.000	34.987	39.977	44.967	49.956	54.944	59.932	64.919	69.905	74.891	79.873
	6.788	10.702	15.250	20.090	25.028	30.000	34.985	39.973	44.963	49.954	54.944	59.934	64.924	69.914	74.902	79.888
D3	6.644	10.343	15.093	20.026	25.005	30.001	35.000	39.999	44.994	49.986	54.976	59.964	64.951	69.936	74.919	79.899
	7.209	10.472	15.137	20.041	25.009	30.001	34.999	39.998	44.994	49.987	54.977	59.965	64.951	69.936	74.918	79.897
	7.209	10.412	15.109	20.029	25.006	30.001	35.001	39.999	44.995	49.986	54.975	59.961	64.946	69.929	74.910	79.887
N1	5.723	10.456	15.274	20.150	25.064	30.001	34.950	39.909	44.875	49.845	54.818	59.795	64.774	69.756	74.741	79.728
	5.913	10.609	15.353	20.175	25.066	30.001	34.958	39.925	44.896	49.867	54.840	59.814	64.792	69.773	74.758	79.748
	5.719	10.478	15.277	20.139	25.055	30.001	34.959	39.923	44.889	49.856	54.825	59.797	64.774	69.756	74.744	79.737
N2	5.667	10.442	15.263	20.139	25.057	30.001	34.957	39.922	44.894	49.869	54.848	59.831	64.817	69.806	74.797	79.792
	5.698	10.457	15.272	20.145	25.060	30.001	34.954	39.918	44.888	49.863	54.841	59.824	64.810	69.799	74.791	79.785
	5.812	10.494	15.277	20.140	25.056	30.001	34.959	39.926	44.898	49.873	54.851	59.832	64.818	69.806	74.799	79.794
N3	5.562	10.412	15.285	20.170	25.075	30.001	34.944	39.901	44.870	49.846	54.828	59.813	64.802	69.792	74.784	79.778
	5.516	10.376	15.256	20.148	25.064	30.001	34.954	39.922	44.898	49.882	54.870	59.861	64.854	69.849	74.846	79.844
	5.423	10.329	15.230	20.136	25.059	30.001	34.957	39.925	44.902	49.886	54.874	59.865	64.858	69.853	74.849	79.846
CO (Day 154)	5.686	10.439	15.300	20.187	25.089	30.001	34.920	39.846	44.778	49.714	54.657	59.606	64.563	69.528	74.503	79.488
	5.673	10.451	15.308	20.191	25.089	30.001	34.919	39.845	44.776	49.712	54.653	59.601	64.557	69.521	74.496	79.481
	5.658	10.452	15.311	20.193	25.090	30.001	34.919	39.844	44.774	49.708	54.648	59.595	64.550	69.514	74.488	79.474
CO (Day 188)	6.008	10.710	15.474	20.284	25.129	30.001	34.888	39.789	44.698	49.615	54.540	59.474	64.418	69.375	74.347	79.334
	6.019	10.720	15.482	20.288	25.131	30.001	34.887	39.787	44.696	49.612	54.537	59.471	64.416	69.373	74.345	79.334
	5.979	10.698	15.471	20.284	25.129	30.001	34.887	39.787	44.696	49.612	54.537	59.471	64.415	69.372	74.344	79.330

Table F-2

The Time of Zero Crossings Relative to the Time of the 11th Sample Point on the Pulse, Field Sites

	ZTV3															
C1	5.689	10.473	15.312	20.186	25.084	30.001	34.927	39.862	44.803	49.749	54.700	59.658	64.624	69.598	74.583	79.580
	5.684	10.470	15.310	20.185	25.084	30.001	34.927	39.862	44.803	49.749	54.699	59.657	64.622	69.596	74.581	79.579
	5.681	10.466	15.308	20.184	25.084	30.001	34.927	39.863	44.804	49.750	54.701	59.658	64.623	69.598	74.583	79.580
C2	5.749	10.474	15.307	20.185	25.086	30.001	34.923	39.850	44.782	49.718	54.659	59.606	64.561	69.525	74.498	79.483
	5.748	10.472	15.307	20.185	25.086	30.001	34.921	39.848	44.779	49.713	54.652	59.598	64.552	69.515	74.488	79.472
	5.741	10.472	15.308	20.186	25.087	30.001	34.921	39.848	44.779	49.714	54.653	59.600	64.554	69.517	74.490	79.474
C3	5.448	10.341	15.211	20.114	25.048	30.000	34.958	39.918	44.876	49.832	54.787	59.744	64.705	69.671	74.644	79.625
	5.534	10.382	15.236	20.128	25.055	30.001	34.952	39.905	44.858	49.809	54.761	59.714	64.671	69.635	74.606	79.585
	5.571	10.377	15.224	20.119	25.051	30.000	34.956	39.913	44.869	49.823	54.777	59.732	64.690	69.654	74.624	79.601
C4	5.152	10.064	15.053	20.030	25.013	30.001	34.989	39.973	44.952	49.926	54.897	59.868	64.844	69.826	74.818	79.823
	5.095	10.059	15.046	20.027	25.012	30.001	34.987	39.969	44.946	49.920	54.892	59.867	64.846	69.834	74.832	79.843
	5.067	10.060	15.038	20.020	25.009	30.001	34.989	39.972	44.949	49.923	54.896	59.871	64.852	69.840	74.839	79.850
D1	6.036	10.615	15.333	20.159	25.059	30.000	34.963	39.938	44.917	49.899	54.882	59.864	64.847	69.830	74.812	79.791
	6.049	10.620	15.335	20.160	25.059	30.000	34.963	39.937	44.916	49.898	54.880	59.863	64.845	69.828	74.809	79.789
	6.043	10.616	15.334	20.160	25.059	30.000	34.962	39.936	44.915	49.897	54.879	59.861	64.843	69.826	74.807	79.786
D2	5.719	10.544	15.315	20.155	25.058	30.000	34.963	39.937	44.916	49.898	54.880	59.862	64.843	69.823	74.800	79.774
	5.702	10.544	15.318	20.158	25.059	30.000	34.962	39.936	44.915	49.897	54.878	59.860	64.840	69.819	74.796	79.770
	5.747	10.547	15.315	20.156	25.059	30.000	34.962	39.935	44.914	49.896	54.878	59.860	64.841	69.820	74.797	79.770
D3	5.603	10.266	15.090	20.025	25.006	30.000	34.996	39.988	44.975	49.957	54.936	59.912	64.888	69.862	74.834	79.802
	5.628	10.321	15.125	20.042	25.012	30.000	34.992	39.981	44.964	49.942	54.916	59.887	64.856	69.823	74.788	79.747
	5.533	10.298	15.121	20.042	25.012	30.000	34.992	39.980	44.962	49.938	54.910	59.880	64.847	69.812	74.775	79.733
N1	5.794	10.513	15.305	20.163	25.068	30.001	34.949	39.907	44.871	49.841	54.814	59.792	64.773	69.758	74.747	79.740
	5.782	10.497	15.296	20.160	25.068	30.001	34.948	39.904	44.867	49.836	54.808	59.786	64.767	69.753	74.743	79.736
	5.786	10.498	15.296	20.160	25.068	30.001	34.947	39.904	44.867	49.835	54.807	59.784	64.765	69.751	74.741	79.735
N2	5.323	10.202	15.098	20.042	25.014	30.001	34.993	39.987	44.980	49.974	54.967	59.961	64.955	69.951	74.949	79.948
	5.362	10.244	15.122	20.052	25.017	30.001	34.992	39.984	44.976	49.967	54.958	59.948	64.940	69.932	74.927	79.923
	5.364	10.233	15.119	20.054	25.020	30.001	34.989	39.979	44.970	49.962	54.955	59.948	64.944	69.941	74.940	79.941
N3	4.309	9.788	15.013	20.085	25.066	30.001	34.922	39.852	44.801	49.767	54.747	59.736	64.728	69.720	74.708	79.690
	4.030	9.664	14.947	20.051	25.051	30.001	34.934	39.875	44.831	49.804	54.788	59.780	64.774	69.767	74.755	79.738
	4.160	9.698	14.954	20.050	25.049	30.001	34.936	39.877	44.832	49.799	54.777	59.760	64.744	69.725	74.701	79.669
CO (Day 154)	5.632	10.407	15.269	20.163	25.076	30.001	34.932	39.868	44.808	49.752	54.699	59.652	64.612	69.580	74.557	79.543
	5.621	10.410	15.271	20.162	25.075	30.000	34.931	39.867	44.806	49.748	54.694	59.645	64.604	69.571	74.548	79.536
	5.579	10.396	15.269	20.165	25.077	30.000	34.929	39.864	44.802	49.744	54.690	59.641	64.600	69.568	74.546	79.534
CO (Day 188)	5.935	10.646	15.427	20.255	25.115	30.001	34.899	39.809	44.725	49.647	54.575	59.512	64.460	69.420	74.395	79.386
	6.256	10.793	15.525	20.310	25.138	30.001	34.885	39.786	44.695	49.611	54.533	59.461	64.397	69.345	74.306	79.282
	5.908	10.634	15.423	20.254	25.115	30.001	34.899	39.809	44.725	49.647	54.575	59.512	64.460	69.419	74.393	79.383

Table F-3

Values of Distance, SPM, and ECM Plotted in Figs. F-13, F-14, and F-15

1975 Day No.	Field Site	Transmitting Station	NAVOBSY to Field Site (m)	SPM (μs)	ECM (μs)
177	Wilmington, NC	Carolina Beach	¯520672	¯3.600	¯1.653
			¯520672	¯3.600	¯1.656
			¯520672	¯3.600	¯1.673
175	Emporia, VA	Carolina Beach	¯250900	¯1.490	¯0.772
			¯250900	¯1.491	¯0.829
			¯250900	¯1.489	¯0.831
183	Towanda, PA	Carolina Beach	323487	2.713	¯0.223
			323487	2.736	¯0.049
			323487	2.720	¯0.032
181	Dexter, NY	Carolina Beach	569702	3.894	¯0.105
			569702	3.901	¯0.355
			569702	3.904	¯0.369
163	Danville, IN	Dana	¯817137	¯5.562	¯5.301
			¯817137	¯5.555	¯5.367
			¯817137	¯5.558	¯5.346
161	Marietta, OH	Dana	¯376178	¯3.172	¯2.272
			¯376178	¯3.165	¯2.120
			¯376178	¯3.165	¯2.353
156	Georgetown, DE	Dana	150434	0.677	¯3.759
			150434	0.680	¯5.212
			150434	0.679	¯7.223
149	Toms River, NJ	Nantucket	¯273230	¯2.092	¯1.053
			¯273230	¯2.074	¯1.014
			¯273230	¯2.084	¯1.100
170	Grottoes, VA	Nantucket	170013	1.891	¯0.689
			170013	1.896	¯0.985
			170013	1.914	¯1.256
168	Bluefield, WV	Nantucket	405849	3.019	2.272
			405849	3.023	1.897
			405849	3.031	1.879
154	NAVOBSY	Carolina Beach	0	0.026	¯0.010
			0	0.037	0.149
			0	0.044	0.153
188	NAVOBSY	Carolina Beach	0	0.046	0.053
			0	0.048	0.048

Table F-4

Adjusted Values of Attenuation Plotted in Fig. F-16

Site	Distance Station to Site (m)	Adjusted Attenuation (dB)	Measured Attenuation (dB)
C1	23572	0.000	43.762
		¯0.005	43.757
		¯0.075	43.687
C2	293344	¯21.584	22.178
		¯21.964	21.798
		¯21.841	21.921
C3	867731	¯40.541	3.222
		¯40.390	3.372
		¯40.340	3.422
C4	1113946	¯47.354	¯3.592
		¯47.442	¯3.680
		¯47.431	¯3.669
D1	85946	¯11.237	32.526
		¯11.215	32.547
		¯11.199	32.563
D2	526905	¯30.403	13.359
		¯30.384	13.378
		¯30.391	13.371
D3	1053517	¯44.861	¯1.099
		¯44.700	¯0.938
		¯44.940	¯1.178
N1	384346	¯24.246	19.516
		¯23.575	20.187
		¯23.467	20.295
N2	827590	¯39.701	4.061
		¯39.592	4.170
		¯39.695	4.067
N3	1063425	¯42.921	0.841
		¯42.996	0.766
		¯42.867	0.895
C0	544244	¯29.140	14.622
D0	903083	¯42.485	1.277
N0	657576	¯30.380	13.382

Appendix G

RESULTS OF FREQUENCY FILTERING

This appendix assembles the histograms and the plotted Fourier coefficients that were used in an attempt to understand the data taken at Georgetown, DE, and simultaneously at NAVOBSY.

Figures G-1 through G-8 are derived from data taken at Danville, IN, and NAVOBSY during the first 20-min recording. Figures G-1 and G-2 are histograms of first-stage edited data taken at NAVOBSY and Danville, respectively. Figures G-3 and G-4 present the Fourier coefficients derived from Q and I data, respectively, taken at NAVOBSY simultaneously with recording at Danville. The Danville coefficients are shown in Figs. G-5 and G-6. Figures G-7 and G-8 are the histograms of frequency filtered data taken at NAVOBSY and Danville, respectively.

Figures G-9 through G-12 present histograms and Fourier coefficients derived from data taken at NAVOBSY during recordings at Georgetown, DE, during the first 20-min data recording, i.e., data segment 1. Figure G-9 is the histogram of first-stage edited data. Figures G-10 and G-11 present the Fourier coefficients for Q and I data, respectively. Figure G-12 is the histogram of the frequency filtered data.

Figures G-13 through G-16 are the same as Figs. G-9 through G-12 but for data segment 2, and Figures G-17 through G-20 are for data segment 3.

Figures G-21 through G-32 are the same as Figs. G-9 through G-20 except that the data were recorded at Danville, IN.

```
                                     T11-T12 HISTOGRAM                                                T11
 0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    0    0    0    0       1

 0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

 0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

 0    0    0    0    0    0    1    0    0    1    0    0    0    0    0    0    0    0    0    0       2

 0    0    0    0    0    0    0    0    1    3    0    1    0    0    0    0    0    0    0    0       5

 0    0    0    0    0    0    1    4    0    2    0    0    0    0    0    0    0    0    0    0       7

 0    0    0    0    0    1   11   23    8    0    0    0    0    0    0    0    0    0    0    0      43

 0    0    0    0    0    0   14  256  316   51    1    1    0    1    2    0    1    0    0    0     643

 0    0    0    0    0    0    2  277  925  451   58    5    2    0    0    0    0    0    0    0    1720

 0    0    0    0    0    1    1   34  449  715  410   50    3    0    0    1    0    0    0    0    1664

 0    0    0    0    0    0    2    4   53  415  694  433   51    1    3    1    0    0    0    0    1657

 0    0    0    0    0    0    1    2    1   53  471  951  307    9    0    0    0    1    0    0    1796

 0    0    0    0    0    0    0    1    0    3   41  271  247   22    0    0    0    0    0    0     585

 0    0    0    0    0    0    0    0    0    0    6    9   25    9    0    0    0    0    0    0      49

 0    0    0    0    0    0    0    0    0    0    1    0    2    0    0    0    0    0    1    0       4

 0    0    0    0    0    0    0    0    1    0    1    0    0    1    0    0    0    0    0    0       3

 0    0    0    0    0    0    0    0    0    2    1    0    0    0    0    1    0    0    0    0       4

 0    0    0    0    0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0       1

 0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    0    0    0       1

 0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0



                                     T12 DISTRIBUTION
 0    0    0    0    0    3   34  601 1754 1696 1685 1721  637   43    5    3    1    1    1    0

                             TOTAL NO. PAIRS    = 8192

                             T11,12 EDIT SIGMA = 0.5234

                             EDITING LEVEL      = 6 SIGMA

                             T11 EDIT PAIRS     =   3

                             T12 EDIT PAIRS     =   1

                             T11,12 EDIT PAIRS =   3

                             T11 AVERAGE        =-0.0293

                             T12 AVERAGE        = 1.2225
```

Fig. G-1 **Histogram of First-Stage Edited Data Taken at NAVOBSY During Recording at Danville, IN; Data Segment 1**

```
                              T11-T12 HISTOGRAM                                    T11
0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0

0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0

0   0   0   0   0   0   0   1   0   2   0   0   0   0   0   0   0   0   0   0      3

0   0   0   0   0   0   0   0   1   2   1   0   0   0   0   0   0   0   0   0      4

0   0   0   0   0   0   0   3   2   9   5   2   1   2   0   0   0   0   0   0     24

0   0   0   0   1   1   4   8  12  19  17  12   1   4   0   0   0   0   0   0     79

0   0   0   0   0   2   4  36  41  51  45  35   8   4   2   0   0   0   0   0    228

0   0   0   1   0   9  21  50  68  95 131  86  35  21   5   3   0   0   0   0    525

0   0   0   0   0   7  33 100 180 227 264 229  98  34  11   5   0   0   0   0   1188

0   0   0   0   2   9  48 139 291 393 421 403 171  73  13   4   2   0   0   0   1969

0   0   0   0   5  10  53 172 354 448 410 388 196  62  15   3   0   0   0   0   2116

0   0   0   0   2   7  43 127 215 328 306 189  95  34   6   1   0   0   0   0   1353

0   0   0   0   2   5  12  47  95 114 103  70  36  13   3   1   0   0   0   0    501

0   0   0   0   0   3   2  14  24  32  31  17  10   8   1   1   0   0   0   0    143

0   0   0   0   1   1   1   3   3   8  12   8   3   3   1   0   0   0   0   0     44

0   0   0   0   0   0   0   0   0   3   1   4   1   2   0   0   0   0   0   0     11

0   0   0   0   0   0   0   0   1   0   2   0   0   0   0   0   0   0   0   0      3

0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0

0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0

0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0



                              T12 DISTRIBUTION
0   0   0   1  13  54 221  700 1287 1731 1749 1443  655  260  57  18   2   0   0   0

                       TOTAL NO. PAIRS    = 8192

                       T11,12 EDIT SIGMA = 0.0705

                       EDITING LEVEL      = 6 SIGMA

                       T11 EDIT PAIRS     =   0

                       T12 EDIT PAIRS     =   1

                       T11,12 EDIT PAIRS =   0

                       T11 AVERAGE        = 0.0012

                       T12 AVERAGE        = 2.9070
```

Fig. G-2 Histogram of First-Stage Edited Data Taken at Danville, IN; Data Segment 1

```
                 TOTAL DC POWER IN Q = 0.0007
 1*
 2*
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 9*
10*
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73*
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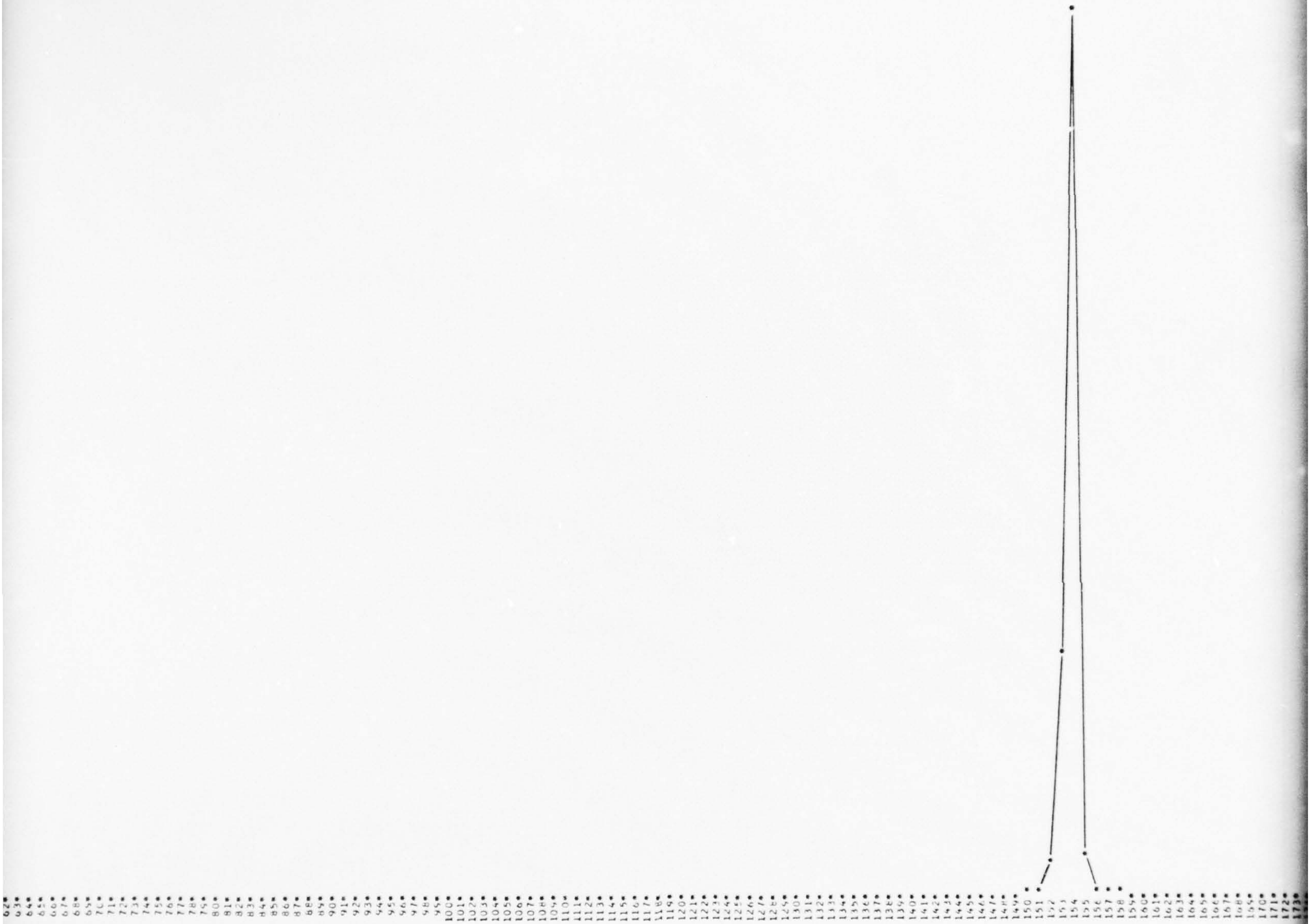
76*
```

1

2



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3

```
MIN VALUE =0.2666D-03    MAX VALUE =0.1983D 00    TOTAL AC POWER = 0.4788    AVG AC POWER = 0.0019
```

Fig. G-3 Power Spectral Density Showing Interference in Q Data Taken at NAVOBSY During Recording at Danville, IN; Data Segment 1

```
                                  TOTAL DC POWER IN I = 1.4894
 1*
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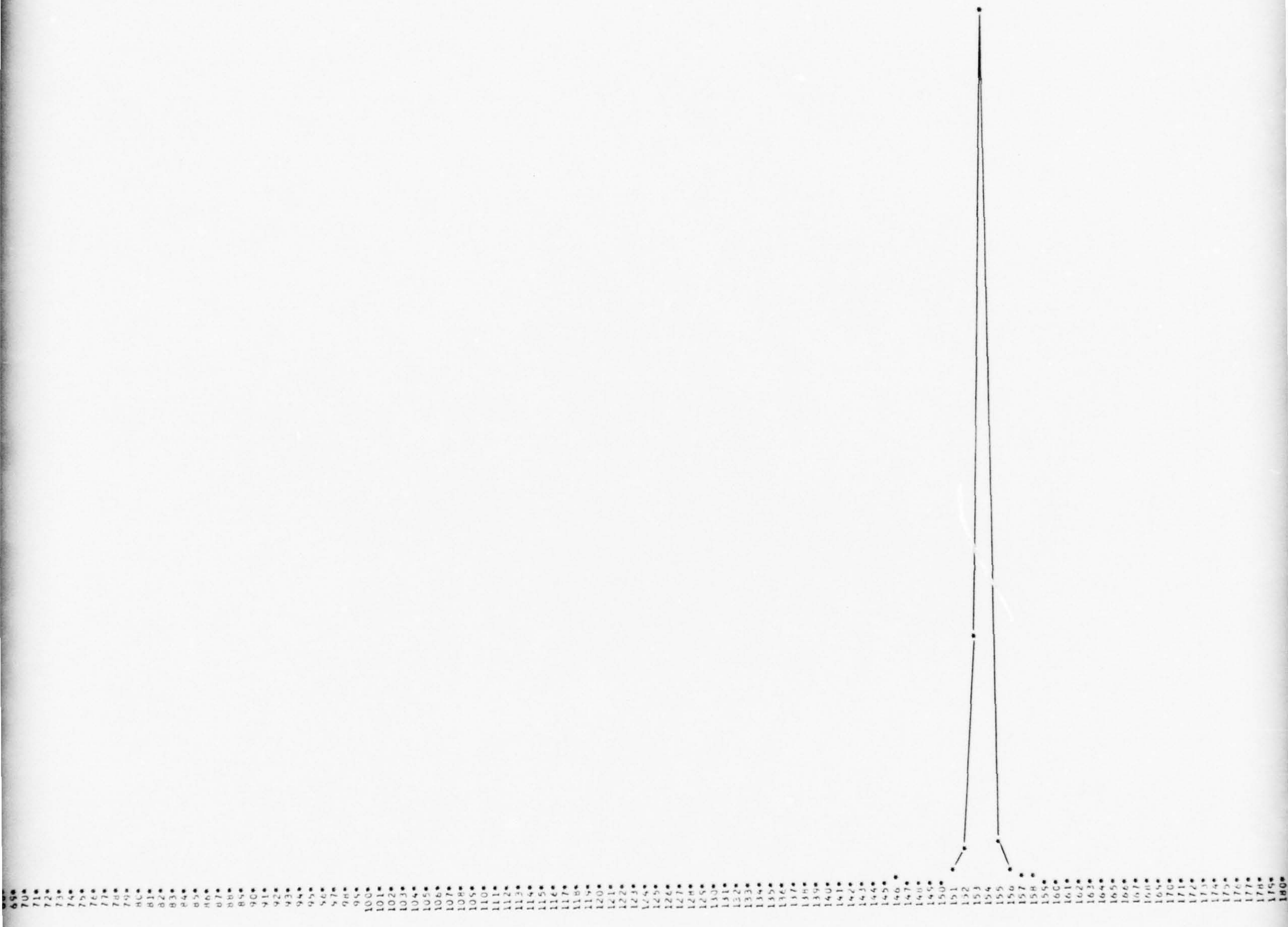
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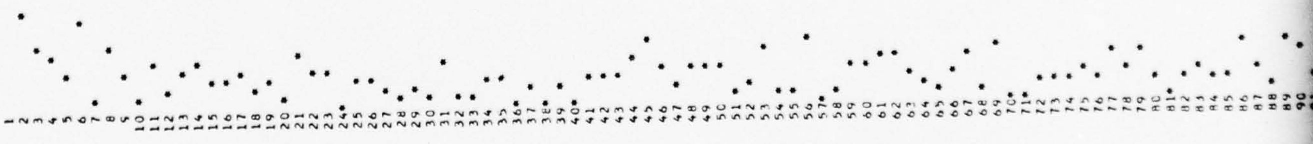
3

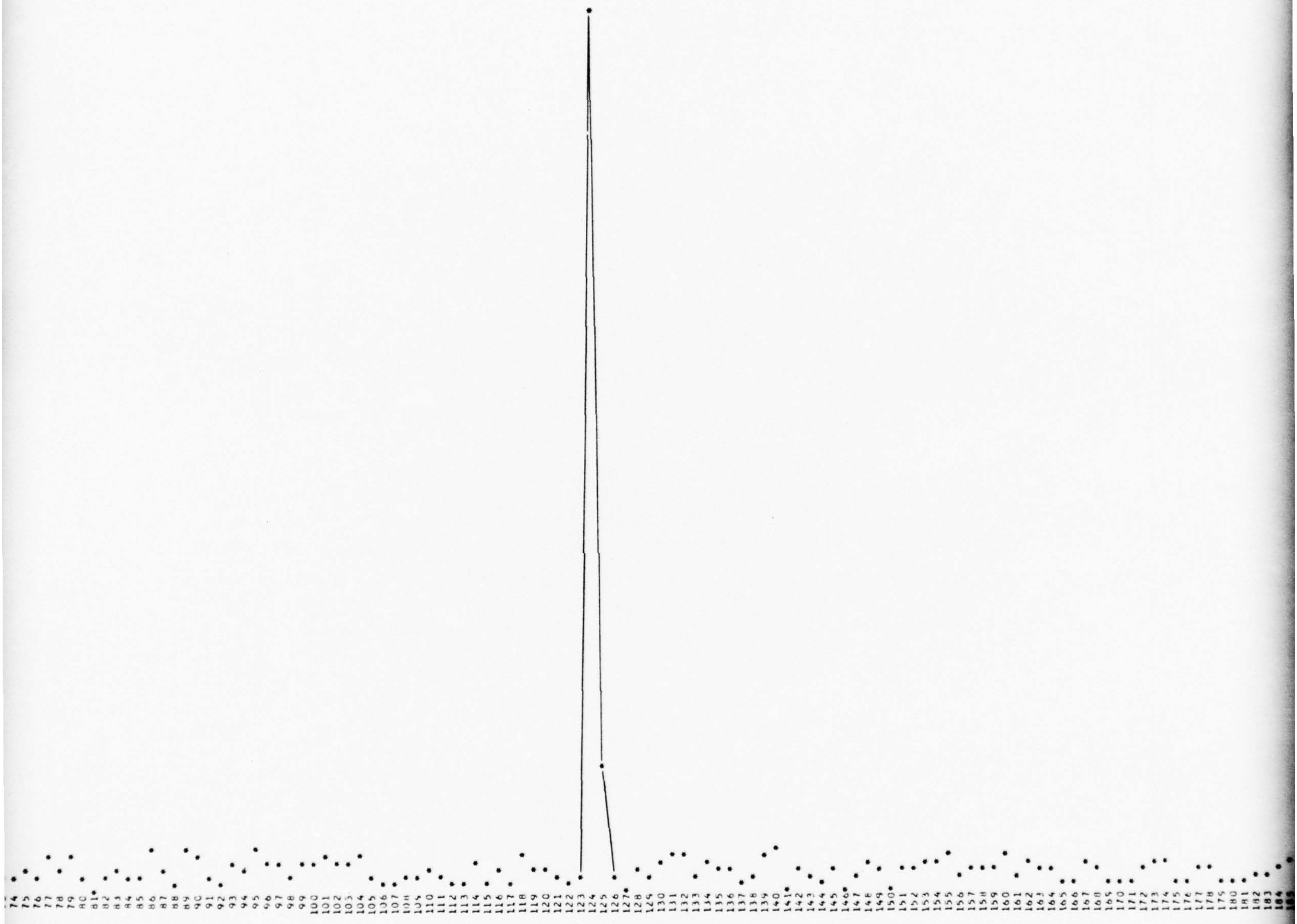
MIN VALUE =0.2068D-03 MAX VALUE =0.1975D 00 TOTAL AC POWER = 0.4458 AVG AC POWER = 0.0017

Fig. G-4 Power Spectral Density Showing Interference in I Data Taken at NAVOBSY During Recording at Danville, IN; Data Segment 1

TOTAL DC POWER IN Q = 0.0000



2



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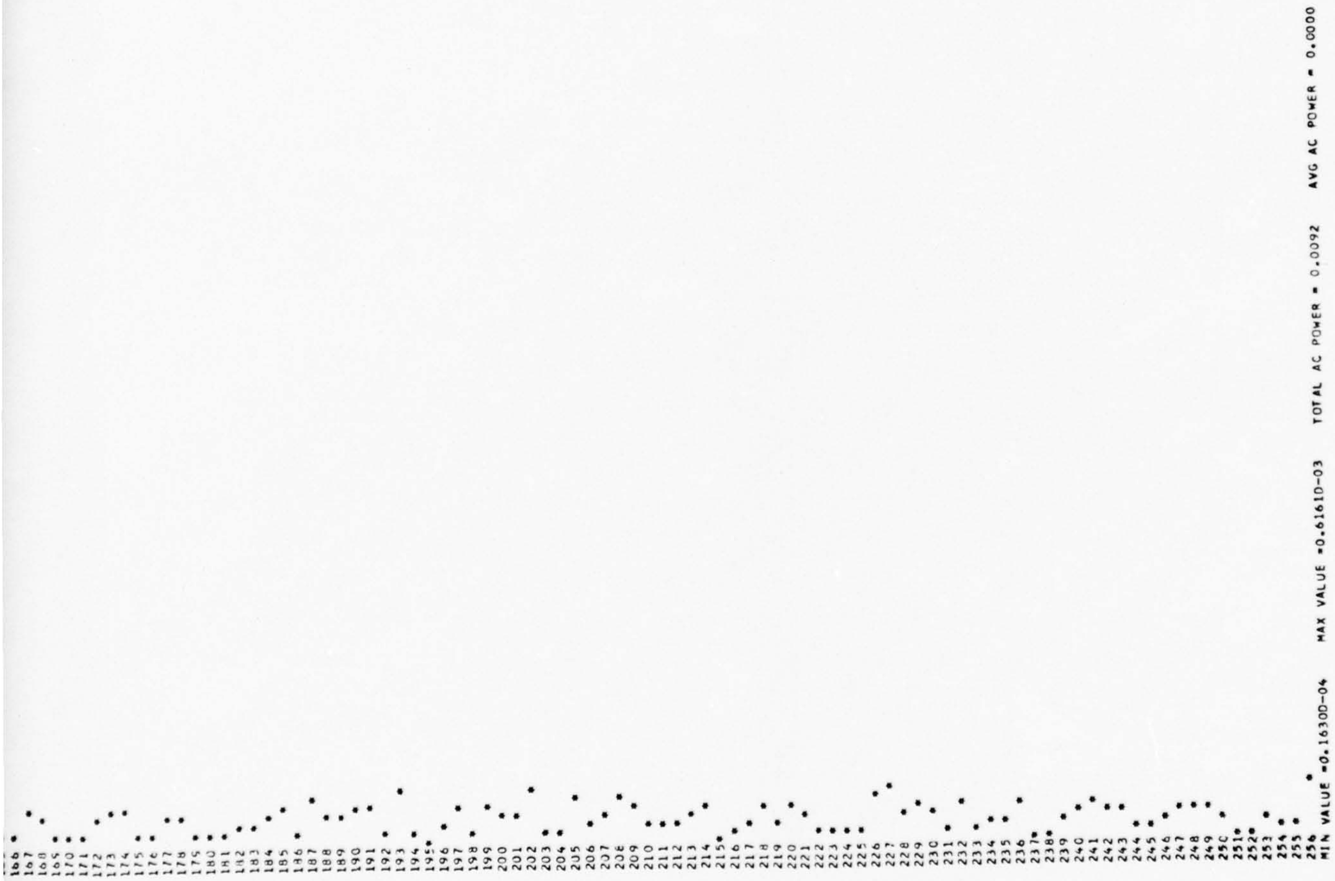

Fig. G-5 Power Spectral Density Showing Interference in Q Data Taken at Danville, IN; Data Segment 1

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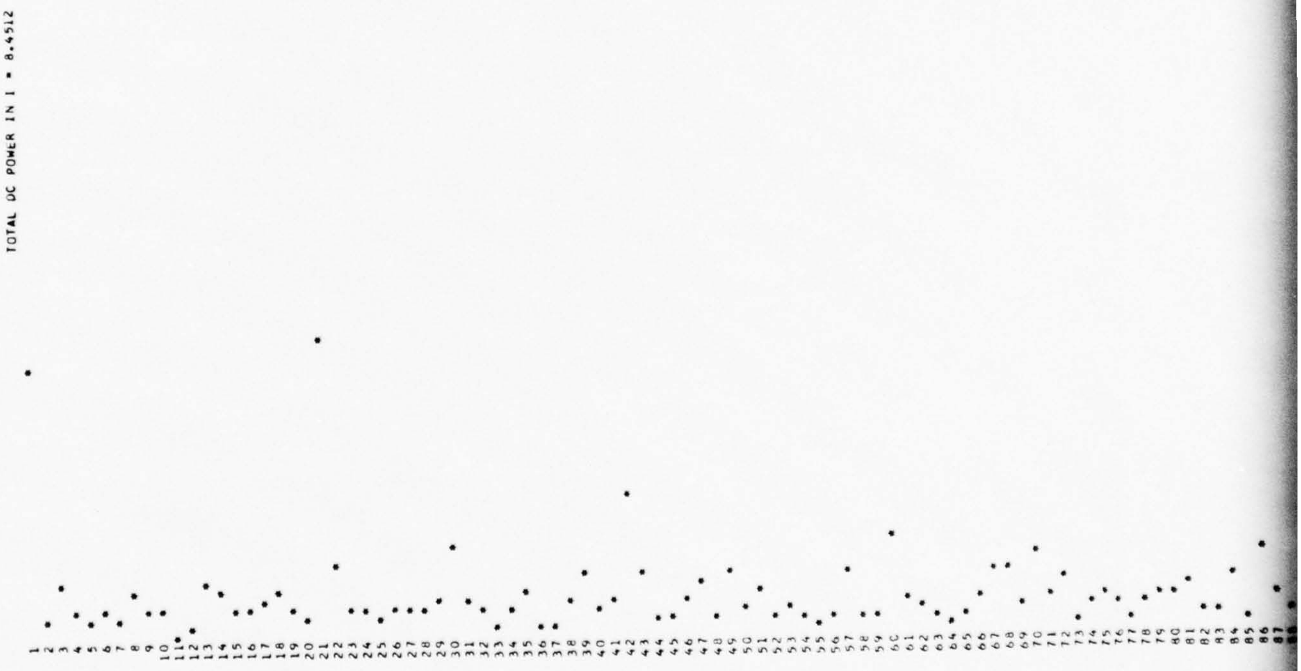

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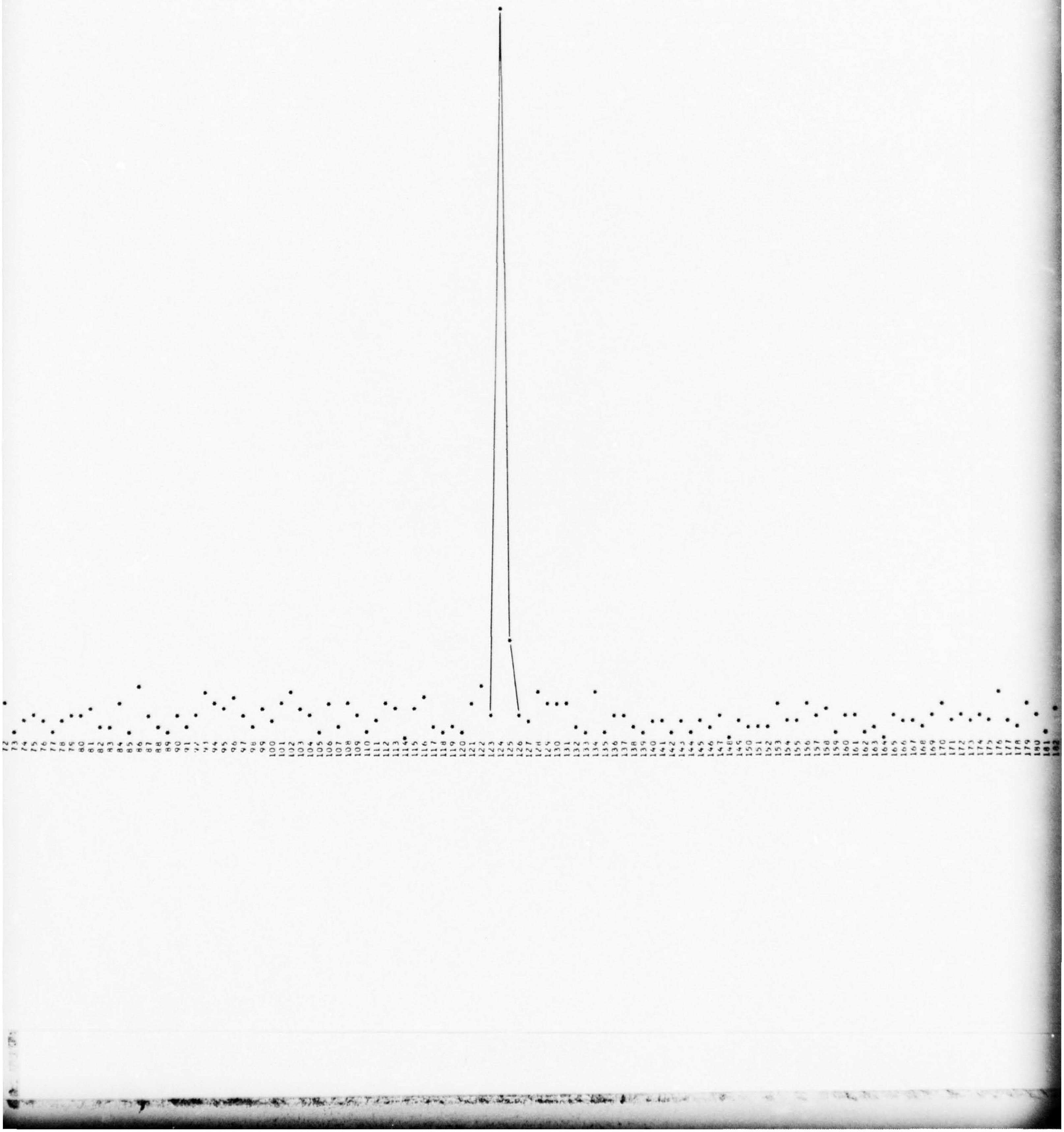
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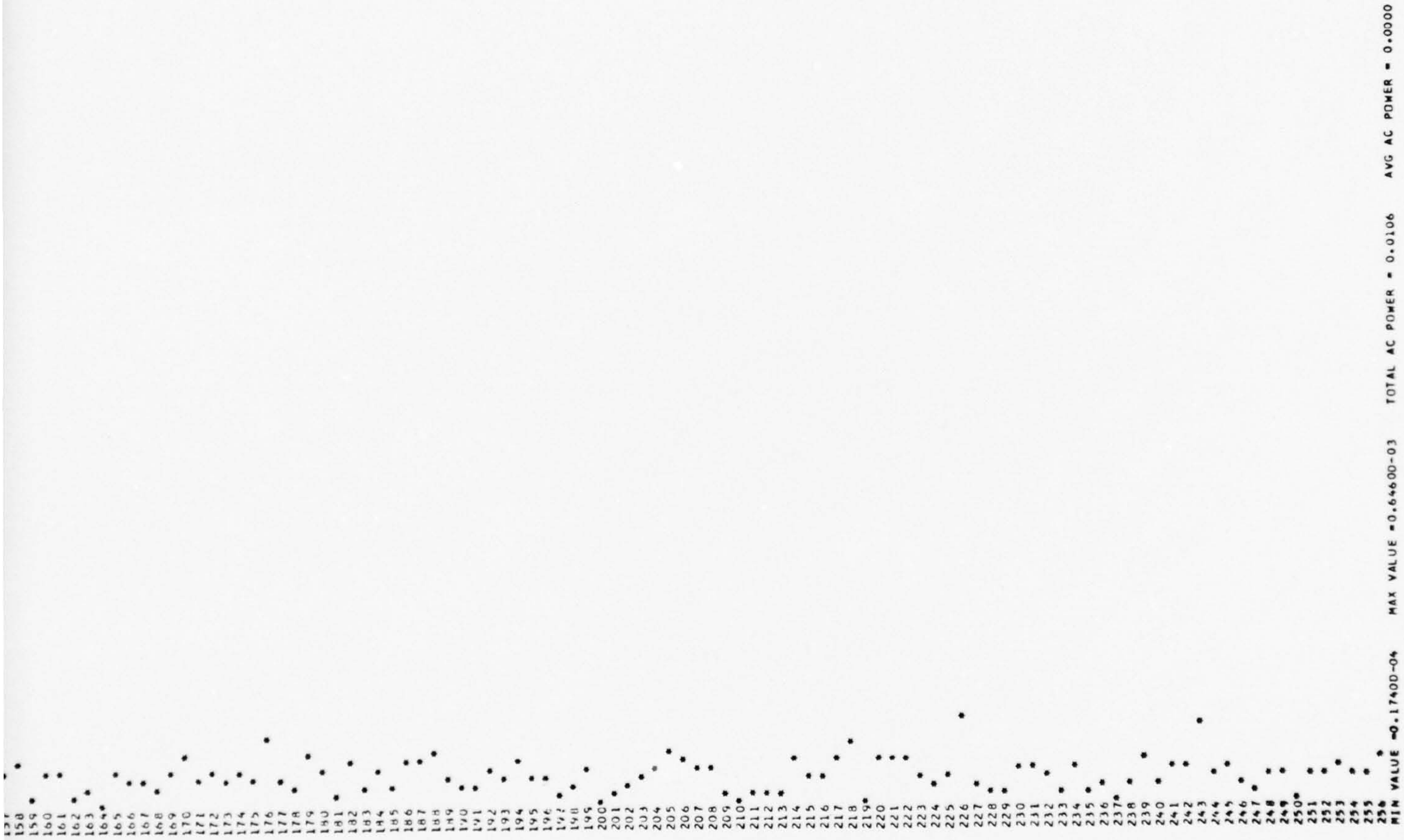

Fig. G-6 Power Spectral Density Showing Interference in I Data Taken at Danville, IN; Data Segment 1

```
                                   T11-T12 HISTOGRAM                                        T11
 0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

 0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

 0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    0    0    0       1

 0    0    0    0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0       1

 0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    0    0    0       1

 0    0    0    0    1    0    0    1    0    3    1    1    1    1    0    0    0    0    0    0       9

 0    0    0    0    0    1    1    2    2    0    1    0    1    0    0    0    0    0    0    0       8

 0    0    0    0    0    0    1   35   67    8    0    1    0    1    1    0    1    0    0    0     115

 0    0    0    0    0    0    0   36  282  256   64    3    2    1    0    0    0    0    0    0     646

 0    0    0    0    0    1    0    6  256 1894 1094   46    3    3    0    0    0    0    0    0    3303

 0    0    0    0    0    0    0    0   44 1091 1856  295    5    0    0    0    0    0    0    0    3291

 0    0    0    0    0    0    0    2    7   44  314  248   54    1    0    1    1    0    0    0     672

 0    0    0    0    0    0    0    1    3    3   17   51   38    3    0    0    1    0    0    0     117

 0    0    0    0    0    0    0    0    1    3    0    3    6    1    0    0    0    0    0    0      14

 0    0    0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    0       1

 0    0    0    0    0    0    0    1    0    1    0    0    0    0    1    0    0    0    0    0       3

 0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

 0    0    0    0    0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0       1

 0    0    0    0    0    0    1    0    0    0    1    0    0    0    0    0    0    0    0    0       2

 0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0



                                  T12 DISTRIBUTION
 0    0    0    0    1    2    5   84  663 3306 3349  648  110   11    2    1    3    0    0    0

                              TOTAL NO. PAIRS    = 8192

                              T11,12 EDIT SIGMA = 0.5234

                              EDITING LEVEL      = 6 SIGMA

                              T11 EDIT PAIRS     =   3

                              T12 EDIT PAIRS     =   1

                              T11,12 EDIT PAIRS =   3

                              T11 AVERAGE        =-0.0293

                              T12 AVERAGE        = 1.2225
```

Fig. G-7 Histogram of First-Stage Edited Data Taken at NAVOBSY During Recording at Danville, IN, After Frequency Filtering; Data Segment 1

```
                                  T11-T12 HISTOGRAM                                                  T11
0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

0    0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    0    0       1

0    0    0    0    0    0    0    0    1    1    0    0    0    0    0    0    0    0    0    0       2

0    0    0    0    0    1    0    0    7    2    6    0    0    2    0    0    0    0    0    0      13

0    0    0    0    0    1    1    3    7   10   10    9    3    4    0    0    0    0    0    0      48

0    0    0    0    0    0    5   26   34   43   48   30    8    3    0    0    0    0    0    0     197

0    0    0    0    2    1   14   44   80   99  126   76   30   13    2    0    0    0    0    0     487

0    0    0    0    2    2   28   97  143  224  264  211   91   38   17    3    0    0    0    0    1120

0    0    0    0    1    8   41  163  306  442  491  421  179   64   16    3    0    0    0    0    2135

0    0    0    0    1   16   45  174  375  487  524  418  189   54   12    1    0    0    0    0    2296

0    0    0    0    3    2   30  125  244  279  323  177   79   25    6    0    1    0    0    0    1294

0    0    0    0    1    3   11   34   91  119   82   59   34   14    1    0    0    0    0    0     449

0    0    0    0    1    2    2   12   19   20   31   19    6    1    0    1    0    0    0    0     114

0    0    0    0    0    0    1    0    1    7    4    3    2    3    0    0    0    0    0    0      21

0    0    0    0    0    0    0    0    2    2    1    2    2    0    0    0    0    0    0    0       9

0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0

0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0       0



                                     T12 DISTRIBUTION
0    0    0    0   11   36  178  679 1310 1735 1910 1425  623  221   54    8    1    0    0    0

                    TOTAL NO. PAIRS    = 8192

                    T11,12 EDIT SIGMA  = 0.0705

                    EDITING LEVEL      = 6 SIGMA

                    T11 EDIT PAIRS     =   0

                    T12 EDIT PAIRS     =   1

                    T11,12 EDIT PAIRS  =   0

                    T11 AVERAGE        = 0.0012

                    T12 AVERAGE        = 2.9070
```

Fig. G-8 Histogram of First-Stage Edited Data Taken at Danville, IN, After Frequency Filtering; Data Segment 1

```
                                          T11-T12 HISTOGRAM                                          T11
  0    0    0    0    0    0    0    0    0    0    1    0    0    0    0    0    1    0    0    0      2
  0    0    0    0    1    0    0    1    1    1    0    0    1    0    0    0    0    0    0    0      5
  0    0    0    0    0    1    0    0    0    1    0    0    0    1    1    1    0    0    0    0      5
  0    0    0    0    0    1    1    0    0    0    1    3    0    1    1    0    0    0    0    0      8
  0    0    1    1    1    0    2    0    0    0    3    0    1    1    1    0    0    0    0    0     11
  0    2    0    1    1    4    1    5    6    4    5    5    2    2    1    0    0    0    0    1     40
  0    0    0    0    3    1    4    8   18   17   12    4    6    4    2    0    0    0    2    0     81
  0    0    0    3    2    9    3   33   86   62   26   19    6    7    6    0    3    1    0    0    266
  0    1    1    0    3    5   18   82  640  489  114   37   13   12    0    0    1    1    1    1   1419
  0    0    1    1    5    5    9   66  462 1078  463   98   29   15    5    4    0    3    1    0   2245
  0    2    0    1    0    9   13   27   96  503 1076  506   66   11    8    1    2    0    0    1   2322
  1    0    1    0    2    2    8   19   27   96  508  574   76   14    5    2    1    0    3    0   1339
  0    0    1    0    1    0    4   11   17   24   54   78   32   10    1    6    0    0    0    1    240
  0    1    0    1    0    2    2    2    4    9   17   15   10    1    2    4    0    0    0    0     70
  0    0    0    0    0    1    2    0    5    7    5    6    4    2    1    2    0    0    0    0     35
  0    0    0    1    0    0    1    3    3    3    5    4    0    3    0    2    0    0    0    0     25
  0    1    0    0    0    0    0    1    1    1    1    0    2    2    2    0    0    0    0    0     11
  0    0    0    0    1    0    1    1    2    0    1    0    0    0    0    0    0    0    0    0      5
  0    0    0    0    1    0    1    0    1    0    0    0    0    0    0    0    0    0    1    1      5
  0    0    1    0    1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0      2


                                          T12 DISTRIBUTION
  1    7    6    9   22   40   70  259 1369 2295 2292 1349  248   86   36   22    8    5    8    5

                                     TOTAL NO. PAIRS    = 8192
                                     T11,12 EDIT SIGMA = 0.7757
                                     EDITING LEVEL      = 6 SIGMA
                                     T11 EDIT PAIRS     =  22
                                     T12 EDIT PAIRS     =  24
                                     T11,12 EDIT PAIRS =   9
                                     T11 AVERAGE        = 0.0385
                                     T12 AVERAGE        = 1.2246
```

Fig. G-9 Histogram of First-Stage Edited Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 1

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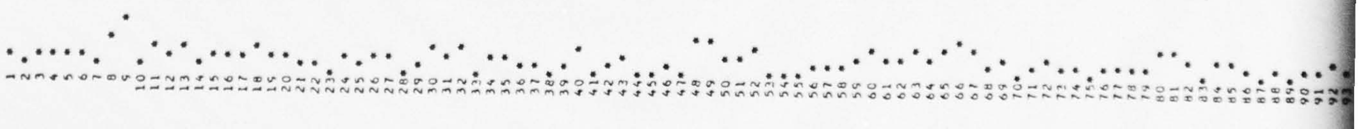
TOTAL DC POWER IN W = 0.0018



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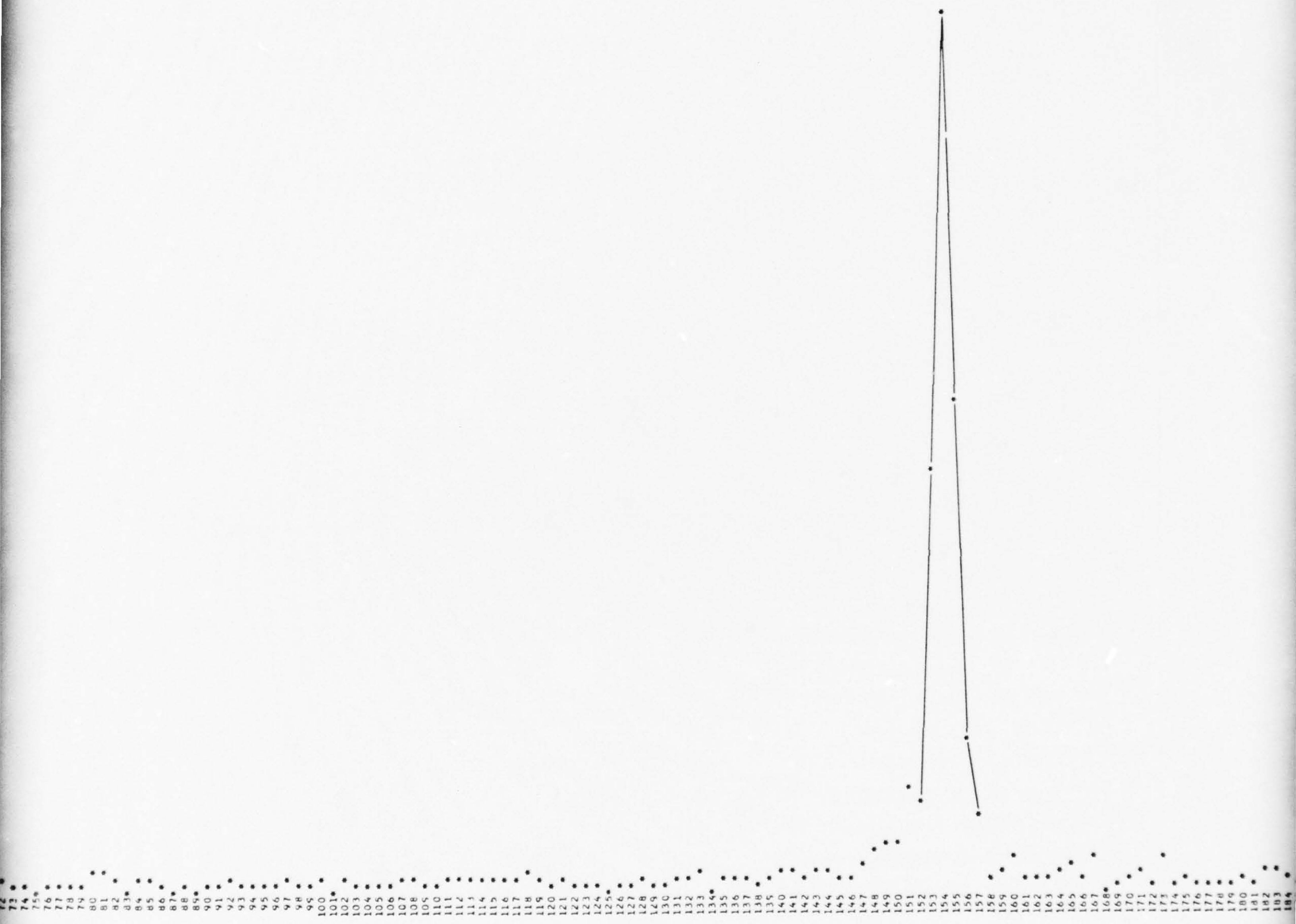

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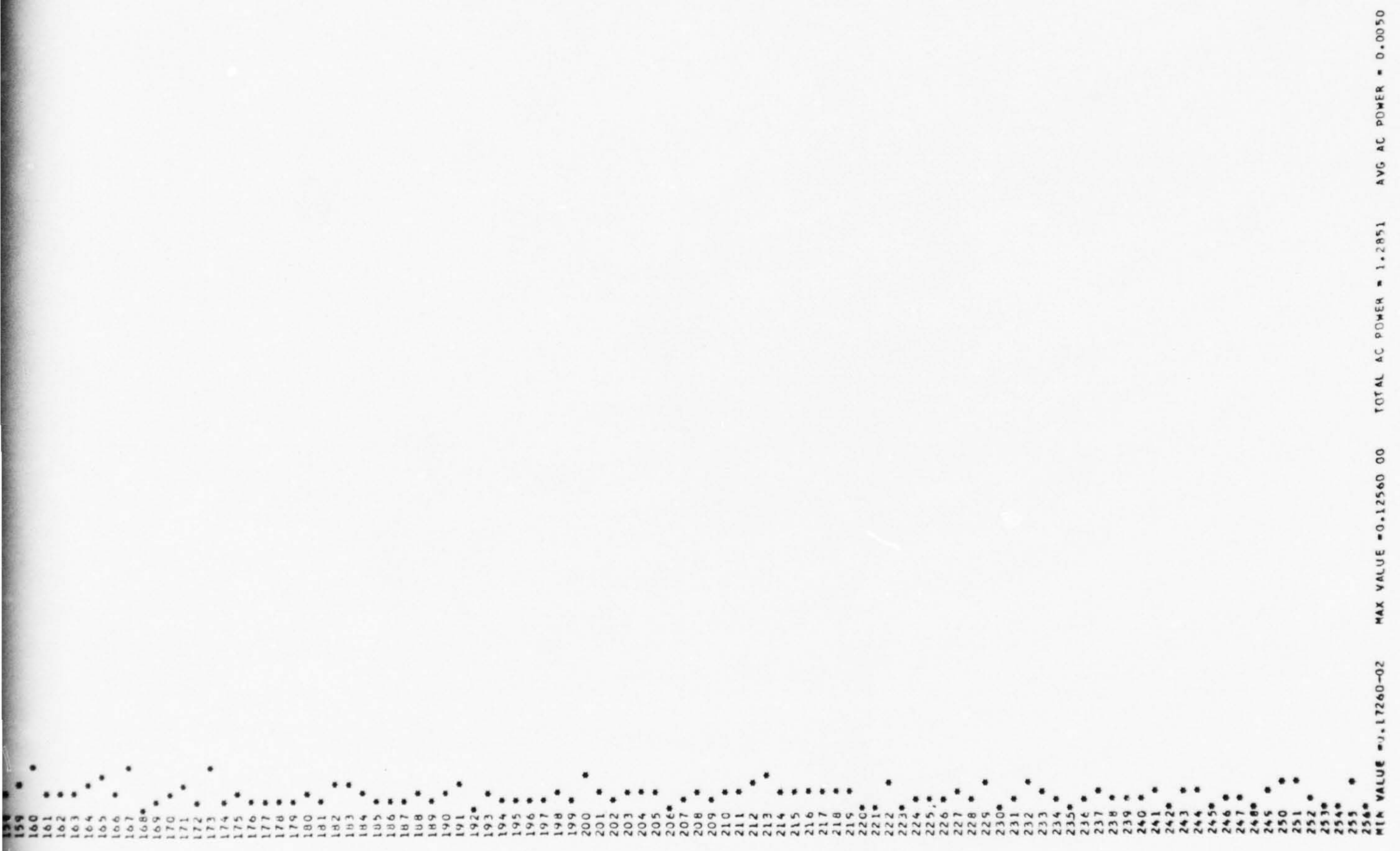
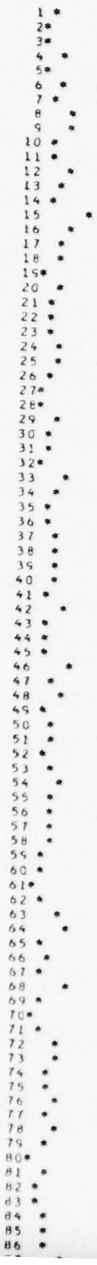


Fig. G-10 Power Spectral Density Showing Interference in Q Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 1

TOTAL DC POWER IN I = 1.4979



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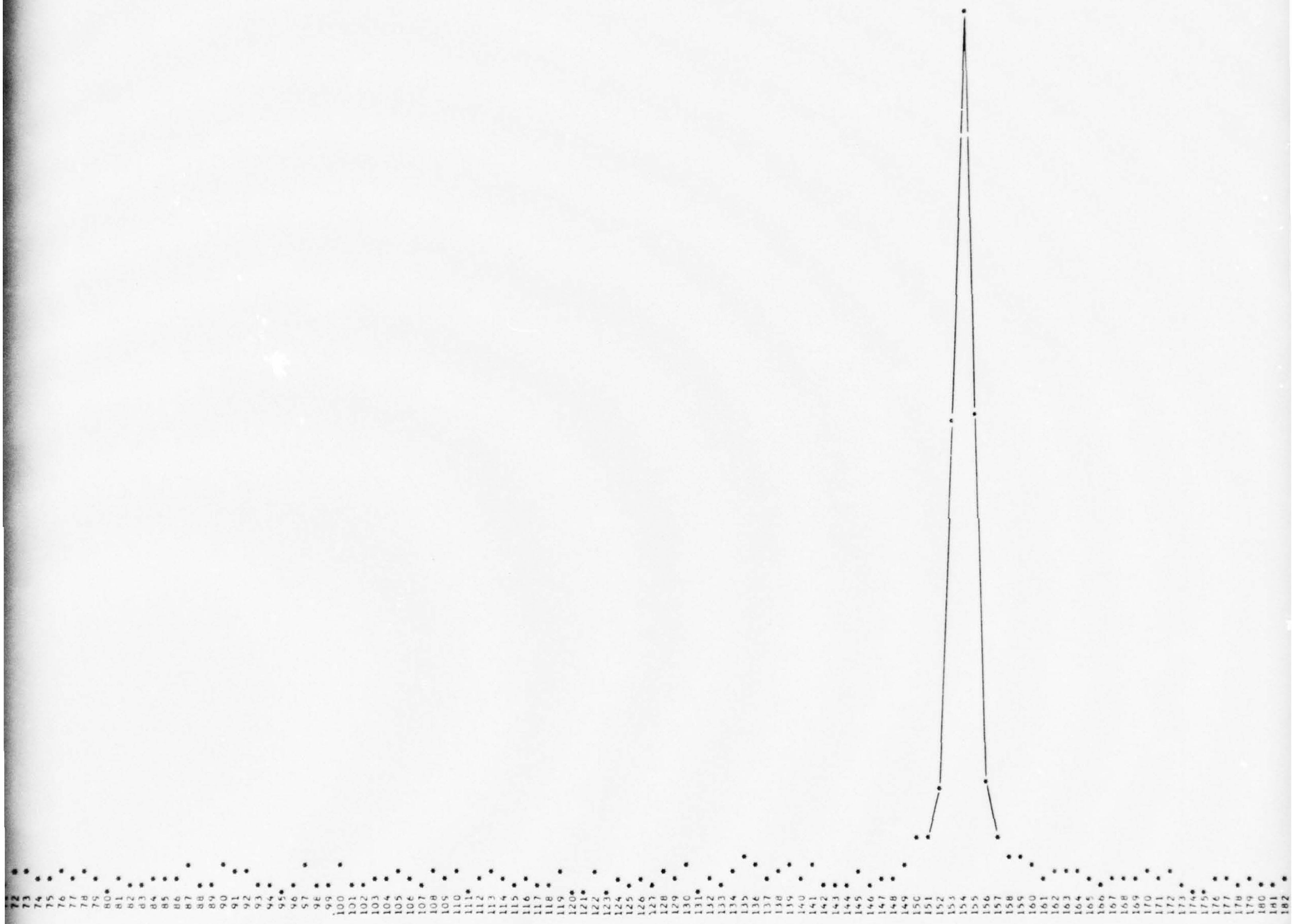
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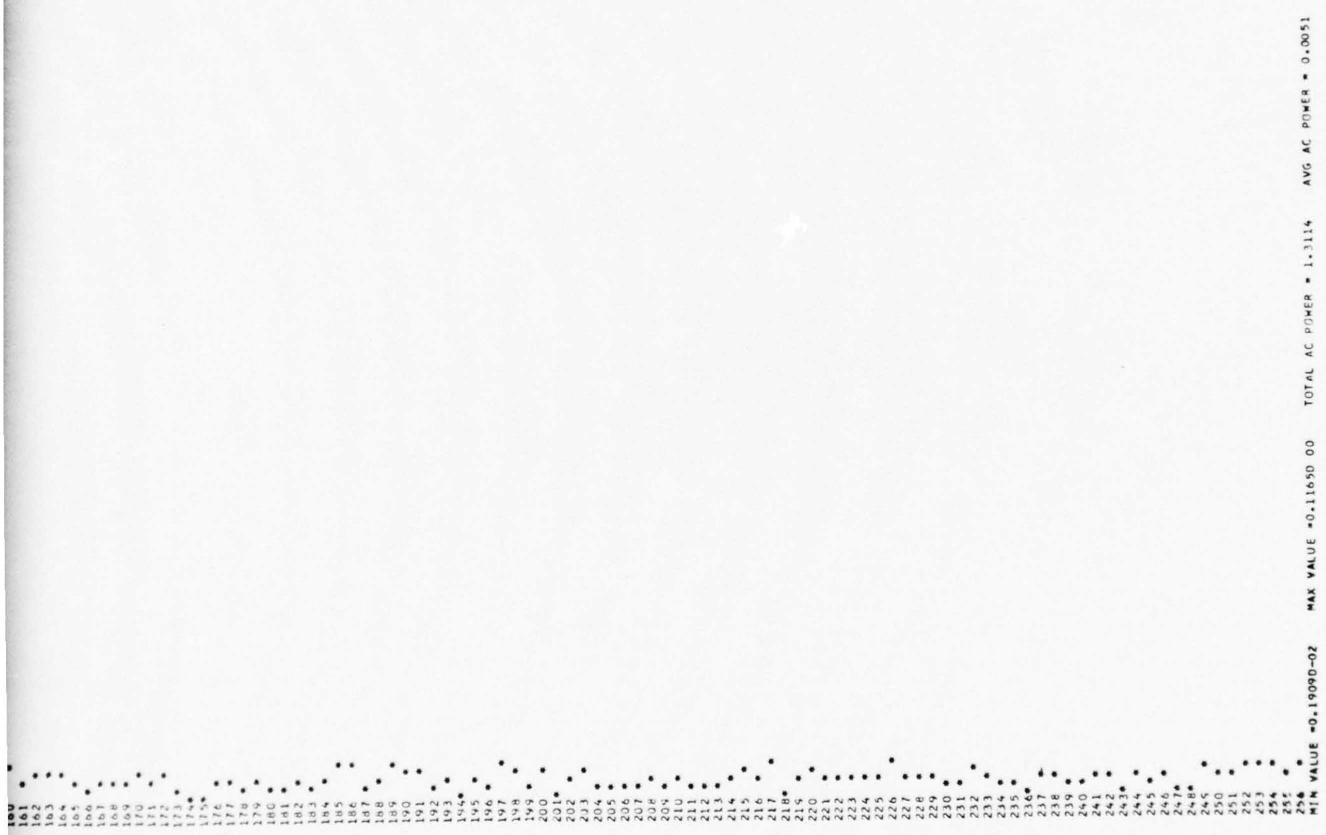

Fig. G-11 Power Spectral Density Showing Interference in I Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 1

```
                                        T11-T12 HISTOGRAM                                             T11
0    0    0    0    0    0    0    0    0    0    1    0    0    0    0    0    0    1    0    0      2

0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0      0

0    0    0    0    1    0    0    0    0    1    2    0    1    3    0    0    0    0    0    0      8

0    0    0    0    0    0    1    0    0    1    1    1    0    0    1    1    0    0    0    0      6

0    0    1    0    0    1    1    1    2    0    1    3    1    0    0    0    0    0    0    0     11

0    0    1    2    1    2    2    3    1    2    3    0    2    0    1    1    0    1    0    1     23

0    1    1    1    0    1    2   10   11    8    7    9   11    3    0    2    0    1    1    0     69

0    1    1    0    3    4    8    4   29   29   31   20   10    6    2    1    1    1    0    0    151

0    0    1    0    3    6    7   16  127  256  155   39   21   11    6    1    2    2    0    0    653

2    0    0    2    4    4   10   35  258 1579 1097  168   22   10    5    2    1    3    0    0   3202

0    0    0    0    2    5   11   19  140 1082 1582  231   27   12    3    2    0    2    1    0   3119

0    0    0    0    1    2   14   19   39  154  263  104   23    8    3    0    2    1    0    0    633

0    0    2    0    2    1    6    3   20   23   28   22   11    3    2    3    0    0    0    0    126

0    0    0    0    0    1    4    5   12   13   14   10    2    2    4    1    0    0    0    0     68

0    0    2    0    0    0    2    1    2    5    8    3    4    0    2    1    0    0    0    0     30

1    0    0    0    0    0    1    2    5    2    1    1    2    0    3    1    0    0    0    0     19

0    0    1    0    0    1    1    0    1    0    0    0    2    0    1    1    1    0    0    0      9

0    0    0    0    0    1    0    1    0    1    0    0    0    0    0    0    0    0    0    0      3

0    0    1    1    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    1      4

0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    0    0    0    0      1



                                        T12 DISTRIBUTION
3    2   11    6   17   30   70  119  648 3156 3194  611  139   58   33   17    7   12    2    2

                              TOTAL NO. PAIRS    = 8192

                              T11,12 EDIT SIGMA = 0.7757

                              EDITING LEVEL      = 6 SIGMA

                              T11 EDIT PAIRS     =   22

                              T12 EDIT PAIRS     =   25

                              T11,12 EDIT PAIRS =    8

                              T11 AVERAGE        = 0.0390

                              T12 AVERAGE        = 1.2245
```

Fig. G-12 Histogram of First-Stage Edited Data Taken at NAVOBSY During Recording at Georgetown, DE, After Frequency Filtering; Data Segment 1

```
                                        T11-T12 HISTOGRAM                                                T11
   0    0    1    0    1    0    0    0    0    1    0    1    1    0    0    0    0    1    0    0        6

   0    0    0    1    0    1    1    0    2    1    0    0    2    0    0    0    0    0    0    1        9

   0    0    0    1    0    0    1    1    0    2    1    1    0    3    0    0    1    0    0    1       12

   0    0    0    1    0    2    1    2    2    4    2    1    1    0    0    0    0    0    0    0       16

   0    1    1    0    1    3    0    3    0    1    6    1    2    0    1    0    0    0    0    0       20

   0    0    1    0    1    0    3    4    4    3    4    1    2    4    1    2    1    0    0    0       31

   2    0    0    0    2    0    2   11   17   11   12   10    2    4    1    2    0    0    0    0       76

   0    0    0    3    0    2    6   35   74   61   33   13    6    3    0    5    1    1    0    0      243

   1    2    0    2    3    3   11   87  624  473  117   47   25    7    3    0    1    1    1    0     1408

   0    0    2    2    1    6   13   64  467 1016  533  102   28    7    4    1    2    0    0    0     2248

   0    1    1    2    7    5    8   22  101  502 1015  505   55   18    5    1    1    0    1    0     2250

   1    1    1    0    2    3    8   13   40   96  509  627   74    5    2    0    1    0    1    0     1384

   1    1    1    0    1    3    1   12   13   30   62   80   24   12    1    0    0    0    0    0      245

   0    0    0    0    3    2    2    8   10    9   16   12   10    2    0    4    1    1    0    0       80

   0    0    0    2    2    1    3    6    4    6    3    2    4    1    2    3    0    1    0    0       40

   0    0    0    0    0    0    0    1    1    4    2    4    3    1    1    3    1    0    0    0       21

   0    0    0    0    1    1    1    0    1    1    3    2    2    3    0    0    0    0    1    0       16

   0    0    0    0    1    0    0    0    2    1    3    0    2    0    0    0    1    0    1    0       11

   0    0    0    0    0    0    1    0    1    0    1    0    0    0    0    0    0    0    0    0        3

   0    1    0    0    0    0    0    1    0    0    1    0    0    1    0    0    0    0    0    0        4



                                        T12 DISTRIBUTION
   5    7    3   14   26   32   62  270 1363 2222 2324 1409  243   71   21   21   11    5    7    2

                                  TOTAL NO. PAIRS    = 8192

                                  T11,12 EDIT SIGMA = 0.7815

                                  EDITING LEVEL      = 6 SIGMA

                                  T11 EDIT PAIRS     =  22

                                  T12 EDIT PAIRS     =  36

                                  T11,12 EDIT PAIRS =  11

                                  T11 AVERAGE        = 0.0352

                                  T12 AVERAGE        = 1.2161
```

Fig. G-13 Histogram of First-Stage Edited Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 2

```
TOTAL DC POWER IN Q = 0.0008

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76  *
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79   *
80    *
81  *
82  *
83  *
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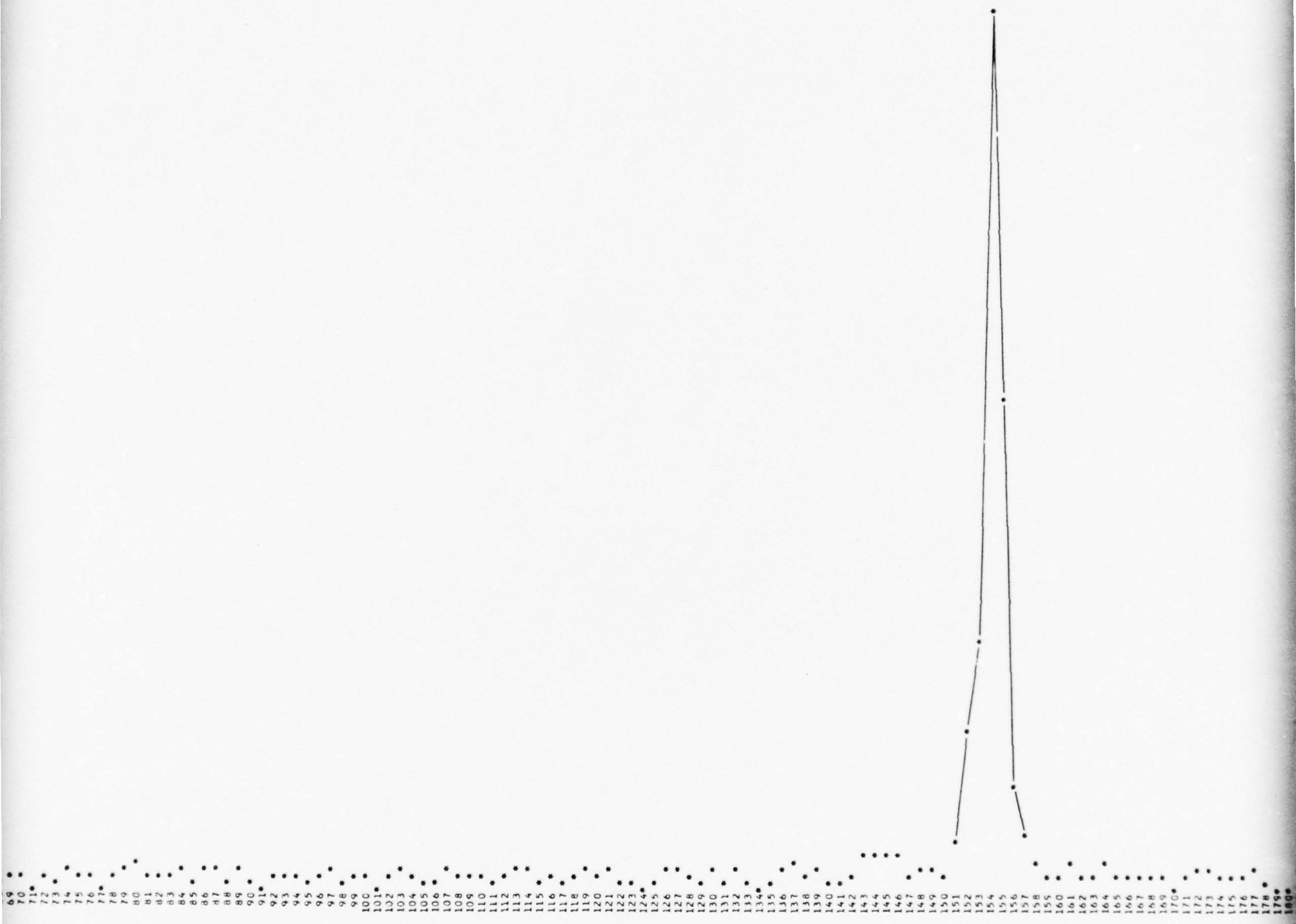

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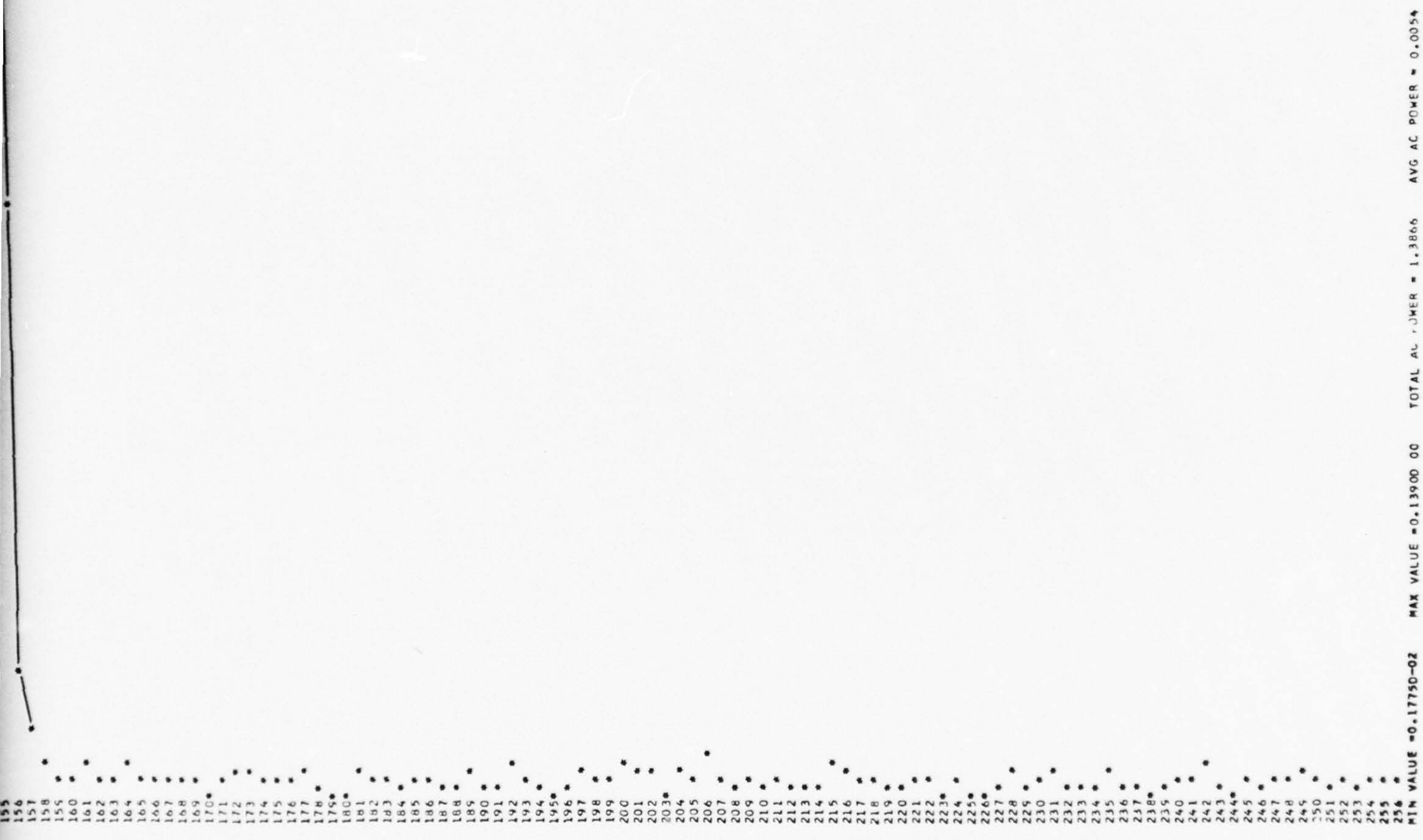
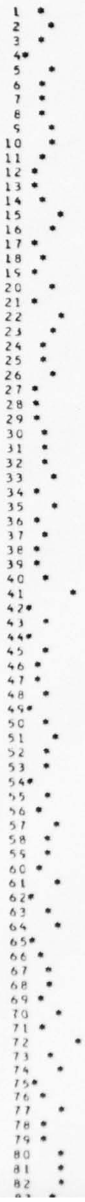


Fig. G-14 Power Spectral Density Showing Interference in Q Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 2

TOTAL DC POWER IN I = 1.4666



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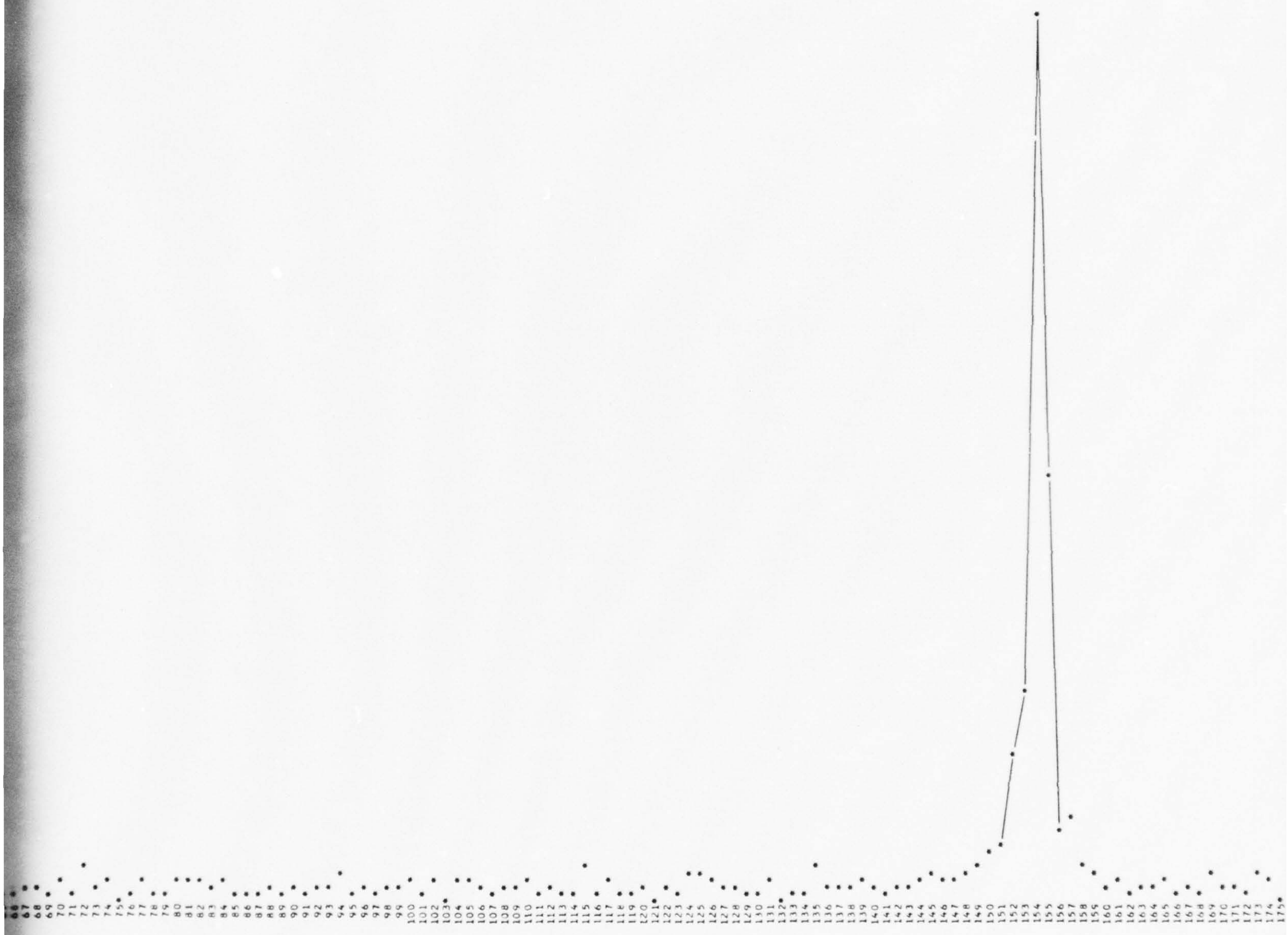
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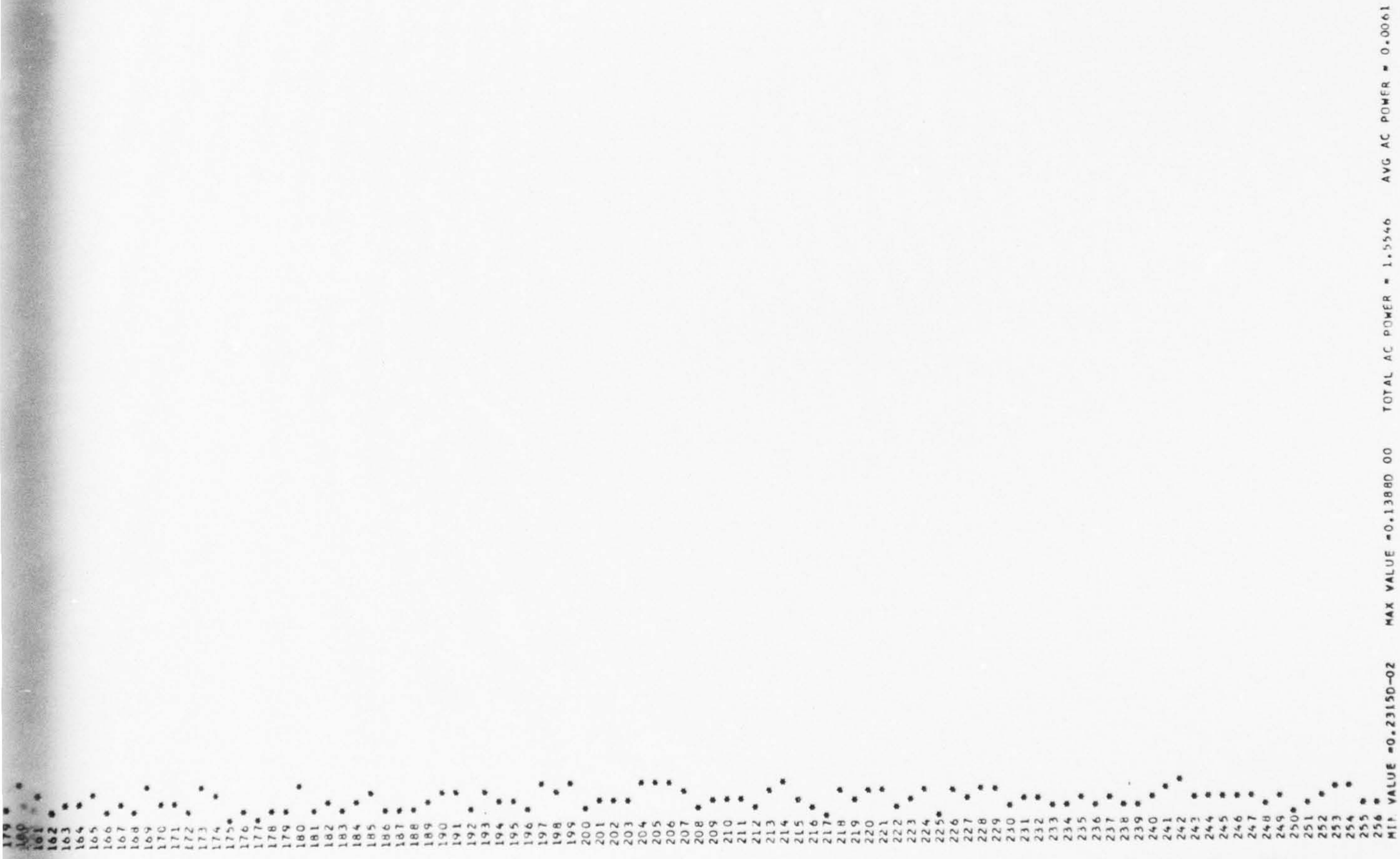

Fig. G-15 Power Spectral Density Showing Interference in I Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 2

```
                                        T11-T12 HISTOGRAM                                                T11
 0    0    0    0    0    0    0    0    0    0    0    2    1    0    0    0    0    0    0    0          3

 0    0    0    1    0    0    0    0    1    0    0    0    0    0    0    0    0    1    0    1          4

 0    0    0    1    0    1    3    2    1    3    1    0    0    3    0    0    0    0    0    0         15

 0    0    0    1    2    0    1    1    2    2    4    0    0    0    0    1    0    0    0    1         15

 0    0    1    0    0    1    2    0    1    0    3    4    0    2    2    0    1    0    0    0         17

 0    1    0    0    2    1    4    1    5    2    1    3    3    3    3    0    0    0    0    0         29

 0    0    1    1    2    2    5    3   13   12    7    9    3    2    1    3    0    0    0    0         64

 0    2    1    0    1    0    5   10   30   27   24   21   12    4    1    4    1    0    0    0        143

 1    0    0    2    2    0    6   24  116  274  168   47   27    5    2    0    2    0    0    0        676

 1    1    2    1    6    4    8   25  275 1508 1031  162   31    8    5    0    2    0    1    0       3071

 1    0    0    0    3    6   17   22  123 1113 1545  265   30    6    1    1    1    1    0    0       3135

 2    1    0    0    5    5    6   14   36  146  281  127   25    9    2    0    0    0    0    0        659

 1    1    0    1    1    3    2   12   11   34   44   18    9    4    6    0    0    1    1    0        149

 0    0    0    1    1    3    2    4   10    7    7    9    3    2    3    3    0    0    0    0         55

 0    0    0    1    2    2    3    6    9    7    7    5    2    2    0    1    1    1    0    0         49

 0    0    0    0    1    1    0    1    1    1    0    1    0    0    1    0    1    0    1    0          9

 0    0    0    1    0    0    0    1    0    2    1    2    3    0    0    1    0    0    1    1         13

 0    0    0    0    0    1    1    0    1    1    1    2    1    1    0    1    1    0    0    0         11

 0    0    0    0    0    0    1    0    1    0    0    0    0    0    0    0    0    0    0    0          2

 0    0    1    1    0    0    0    0    0    0    0    0    0    2    0    0    0    0    0    0          4



                                         T12 DISTRIBUTION
 6    6    6   12   28   30   66  126  636 3139 3125  677  150   53   27   15   10    4    4    3

                         TOTAL NO. PAIRS    = 8192

                         T11,12 EDIT SIGMA = 0.7815

                         EDITING LEVEL      = 6 SIGMA

                         T11 EDIT PAIRS     =  22

                         T12 EDIT PAIRS     =  36

                         T11,12 EDIT PAIRS =  11

                         T11 AVERAGE        = 0.0331

                         T12 AVERAGE        = 1.2156
```

Fig. G-16 Histogram of First-Stage Edited Data Taken at NAVOBSY During Recording at Georgetown, DE, After Frequency Filtering; Data Segment 2

```
                                           T11-T12 HISTOGRAM                                                  T11
  0    0    0    0    0    0    0    1    2    0    0    0    0    0    0    0    0    0    0    0          3

  0    0    0    1    0    0    0    2    3    1    0    0    0    0    1    0    0    0    0    0          8

  0    0    0    0    1    1    0    1    0    2    0    0    1    0    0    0    0    0    0    0          6

  0    0    0    0    2    1    3    0    1    1    2    0    0    0    1    1    0    0    0    0         12

  0    0    1    1    2    1    2    2    0    4    1    2    6    2    0    1    1    0    0    1         27

  0    1    1    2    1    0    2    4    5    7    8    3    2    3    1    0    1    0    1    1         43

  1    0    0    0    3    4    3    9   18   13   10    4    7    0    1    1    0    1    0    0         75

  1    0    1    0    0    2    8   40  104   63   29   12    7    9    2    0    0    0    0    0        278

  1    1    0    1    5    6   13  113  599  501  108   30   18    9    2    3    1    1    0    1       1413

  1    1    2    2    1    1   16   56  486  951  500  104   25   13    2    1    3    0    0    0       2165

  1    1    2    2    1    9    8   28  117  488  937  524   62   16    5    4    0    0    2    0       2207

  1    1    1    2    3    1    4   14   23  110  517  618   98   16    3    1    1    1    0    0       1415

  0    0    1    1    3    1    3    8   14   33   61  126   41    7    5    1    1    0    0    0        328

  0    0    0    0    3    2    3    3   10   10   12   13    7    6    3    1    0    0    1    0         74

  2    0    0    1    0    0    2    4    4    1    7    6    7    3    3    0    1    0    0    1         42

  0    0    0    2    0    1    0    0    3    1    0    1    0    0    2    0    1    0    0    0         11

  0    0    0    0    1    0    3    1    0    0    0    0    2    2    1    0    1    1    1    0         13

  0    0    1    0    0    0    0    1    0    1    1    1    0    0    0    0    1    0    0    0          6

  0    0    0    1    0    0    0    1    3    0    0    0    1    0    0    0    0    0    1    0          7

  0    0    0    1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0          1



                                           T12 DISTRIBUTION
  8    5   10   17   26   30   70  288 1392 2187 2213 1444  284   88   32   14   12    4    6    4

                                      TOTAL NO. PAIRS    = 8192
                                      T11,12 EDIT SIGMA = 0.7445
                                      EDITING LEVEL      = 6 SIGMA
                                      T11 EDIT PAIRS     =  26
                                      T12 EDIT PAIRS     =  25
                                      T11,12 EDIT PAIRS =   7
                                      T11 AVERAGE        = 0.0430
                                      T12 AVERAGE        = 1.2269
```

Fig. G-17 Histogram of First-Stage Edited Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 3

```
                          TOTAL DC POWER IN Q = 0.0023
 1 *
 2*
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 8  *
 9   *
10   *
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16  *
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23  *
24   *
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62  *
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73  *
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75 *
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80  *
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84 *
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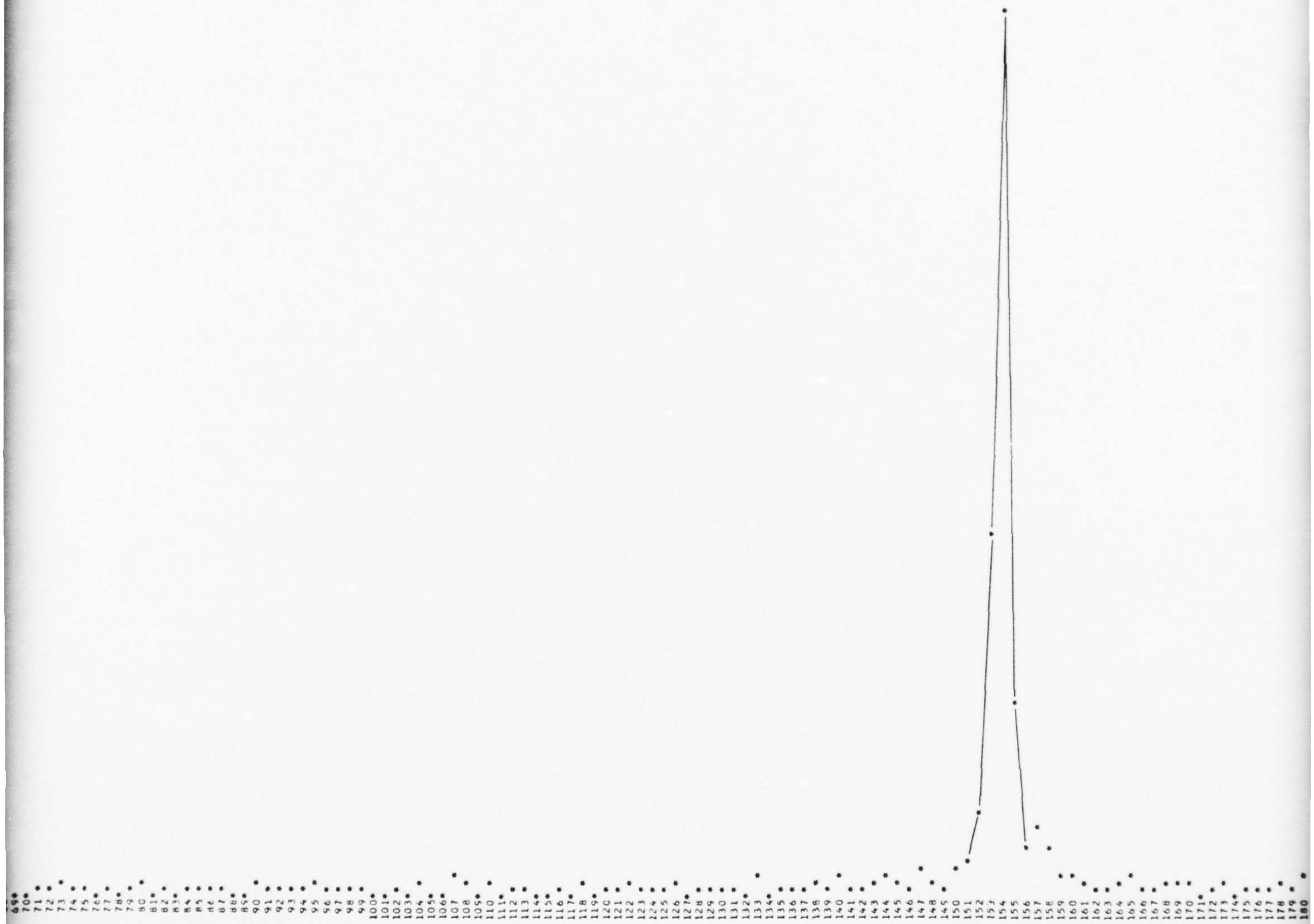
86 *
87 *
88*
89*
```

2



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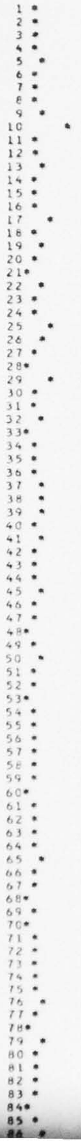
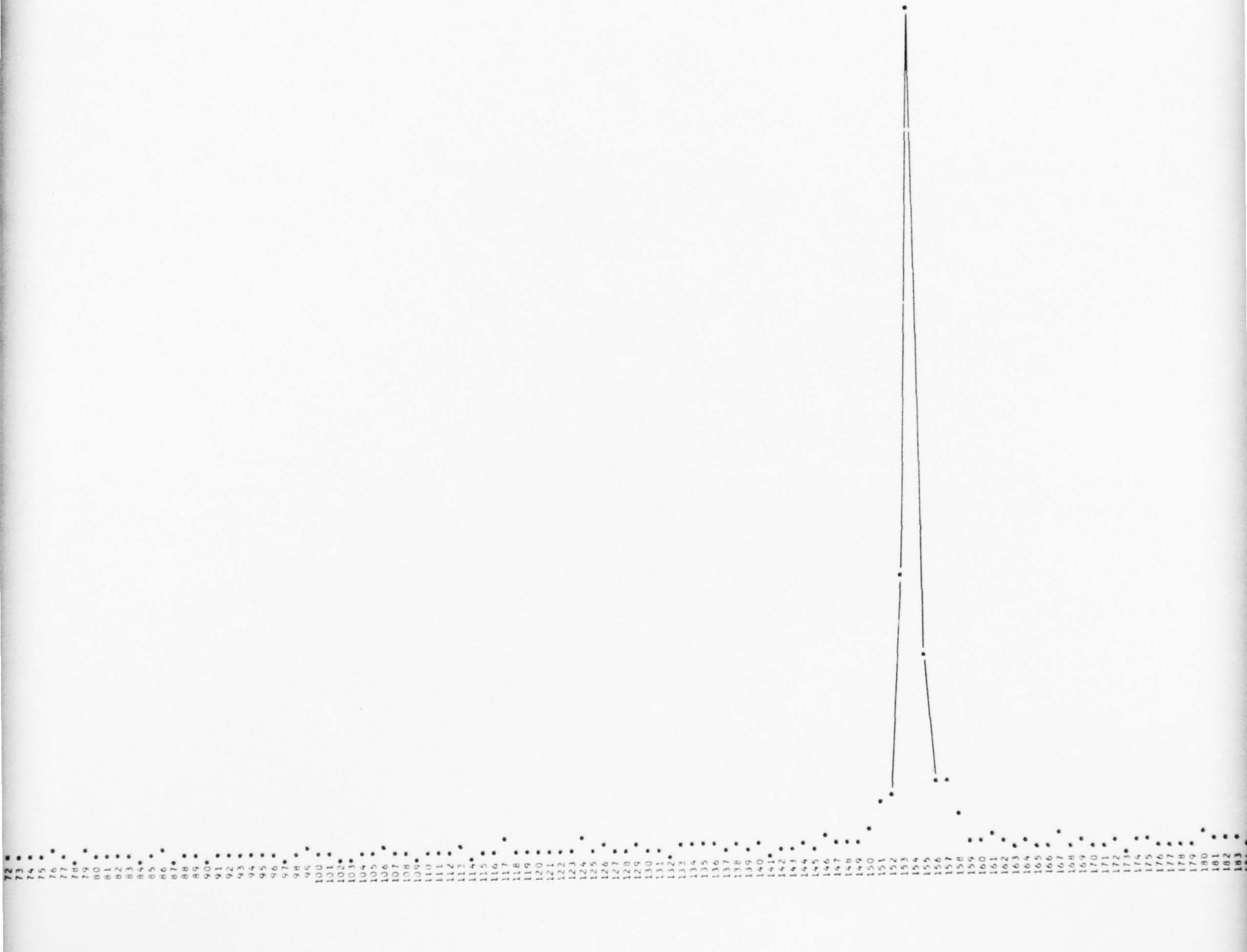
...
256
MIN VALUE =0.1984D-02
MAX VALUE =0.1609D 00
TOTAL AC POWER = 1.2957
AVG AC POWER = 0.0051

Fig. G-18 Power Spectral Density Showing Interference in Q Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 3

TOTAL DC POWER IN I = 1.5171



2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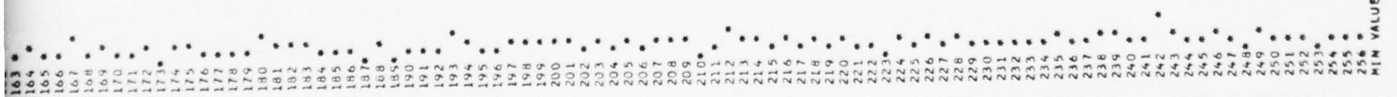


```
MIN VALUE =0.1446D-02    MAX VALUE =0.17250 00    TOTAL AC POWER = 1.3006    AVG AC POWER = 0.0051
```

Fig. G-19 Power Spectral Density Showing Interference in I Data Taken at NAVOBSY During Recording at Georgetown, DE; Data Segment 3

```
                                         T11-T12 HISTOGRAM                                        T11

 0    0    0    0    0    0    0    0    0    0    0    0    0    1    1    0    0    0    0    1        3

 0    0    0    0    1    0    0    0    3    1    0    0    0    0    0    0    0    0    0    0        5

 0    0    0    0    1    1    0    0    1    3    0    0    0    0    1    1    0    0    0    0        8

 0    0    0    1    1    0    0    1    2    1    2    2    0    2    0    0    0    0    0    0       12

 0    0    0    0    0    0    3    1    1    1    2    3    0    1    1    0    0    1    0    0       14

 0    1    0    3    0    0    2    1    4    4    5    4    2    6    2    1    0    3    0    0       38

 1    1    0    1    3    2    5    6    8   11    9    9    7    4    0    0    0    0    0    0       67

 0    0    0    1    0    6    2    5   30   38   31   17   10    5    3    2    1    0    1    0      152

 2    1    0    0    4    3    8   21  134  288  171   35   24    7    2    3    0    1    0    0      704

 1    1    0    1    1    4    8   46  270 1359 1051  164   24    6    5    1    0    1    0    0     2943

 0    2    1    3    1    5    6   27  147 1141 1527  258   29   10    1    1    0    1    0    1     3201

 0    0    1    3    1    3    2   18   43  163  297  134   21    6    2    2    1    0    0    0      697

 0    1    1    2    1    3    5    8   21   33   45   28   14    6    2    0    0    2    0    0      172

 1    0    0    0    2    4    4    7    3   10   13    3    6    4    1    0    1    0    0    0       59

 0    0    0    1    2    0    2    4    1    1    1    8    1    1    0    1    0    0    0    0       23

 1    0    0    0    0    0    3    0    2    0    2    1    2    1    3    1    1    1    0    0       18

 0    1    0    1    1    1    0    1    1    0    0    0    1    0    2    0    0    0    1    0       10

 0    0    0    0    0    0    0    1    2    1    0    2    0    0    0    0    0    0    0    0        6

 0    1    0    1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    1    0        3

 0    0    0    0    0    0    0    1    0    0    1    0    0    0    0    0    0    0    0    0        2



                                         T12 DISTRIBUTION
 6    9    3   18   19   32   50  148  673 3055 3157  708  141   60   26   13    4   10    3    2

                              TOTAL NO. PAIRS     = 8192
                              T11,12 EDIT SIGMA = 0.7445
                              EDITING LEVEL       = 6 SIGMA
                              T11 EDIT PAIRS      =  25
                              T12 EDIT PAIRS      =  23
                              T11,12 EDIT PAIRS =   7
                              T11 AVERAGE         = 0.0435
                              T12 AVERAGE         = 1.2272
```

Fig. G-20 Histogram of First-Stage Edited Data Taken at NAVOBSY During Recording at Georgetown, DE, After Frequency Filtering; Data Segment 3

```
                                           T11-T12 HISTOGRAM                                     T11
   0    0    0    0    0    0    1    0    0    3    0    1    0    0    0    0    0    1    0    0        6

   0    0    0    0    0    1    1    0    0    1    2    0    0    1    0    0    0    0    0    0        6

   1    0    0    0    0    2    1    0    0    1    2    0    0    1    0    0    0    0    0    1        9

   0    1    0    0    0    0    0    1    1    0    1    2    1    0    0    2    0    0    0    0        9

   0    0    0    1    2    1    2    3    2    0    0    0    1    2    2    0    0    0    0    0       16

   0    0    0    1    1    1    2    3    6    4    1    5    2    1    0    1    0    1    0    0       29

   0    0    0    0    2    0    6   11   12   12    7    4    3    3    1    2    0    1    0    1       65

   0    0    1    2    4    6    6   13   46   55   35   15   10    2    2    0    0    2    0    0      199

   0    0    2    1    1    4   15   41  330  417  141   34   26    3    3    2    0    3    1    0     1024

   0    0    1    3    4    6   12   58  433 1263  644  130   33   11    5    3    5    0    0    1     2612

   0    1    1    1    2    1   11   27  152  754 1310  425   51   11    6    4    1    2    0    0     2770

   0    0    1    1    1    7    4   17   47  110  463  304   43    9    6    5    1    1    0    0     1025

   0    1    0    0    1    1    3   10   11   42   52   41   17    8    3    2    2    0    0    0      194

   0    0    0    1    0    2    2    1    9    9   12   15    8    3    3    1    1    1    0    0       68

   0    0    0    2    0    0    1    4    4    4    5    5    7    4    1    2    0    1    1    0       41

   0    0    0    0    0    1    0    0    0    3    0    0    2    1    3    0    0    0    0    0       10

   0    0    0    0    1    0    1    0    1    1    0    2    0    1    1    1    0    0    0    0        9

   0    0    0    0    0    0    1    1    2    0    0    0    0    0    1    0    0    0    0    1        6

   0    0    0    0    0    0    0    0    1    1    0    0    0    0    1    0    0    1    0    0        4

   0    0    0    0    0    0    1    0    0    1    1    0    1    0    0    0    1    1    0    0        6



                                      T12 DISTRIBUTION
   1    3    6   13   19   33   70  190 1057 2691 2676  983  210   61   38   25   11   15    2    4


                                      TOTAL NO. PAIRS     = 8192

                                      T11,12 EDIT SIGMA = 0.6249

                                      EDITING LEVEL       = 6 SIGMA

                                      T11 EDIT PAIRS      =  35

                                      T12 EDIT PAIRS      =  37

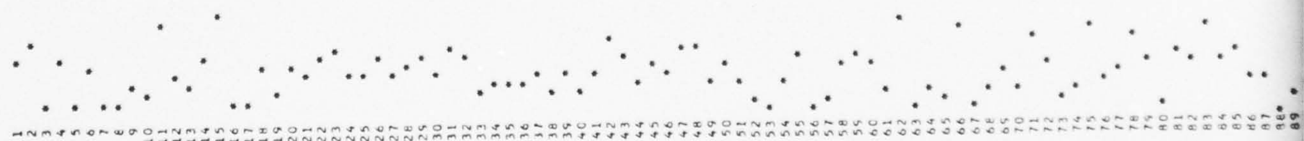
                                      T11,12 EDIT PAIRS =  12

                                      T11 AVERAGE         = 0.1042

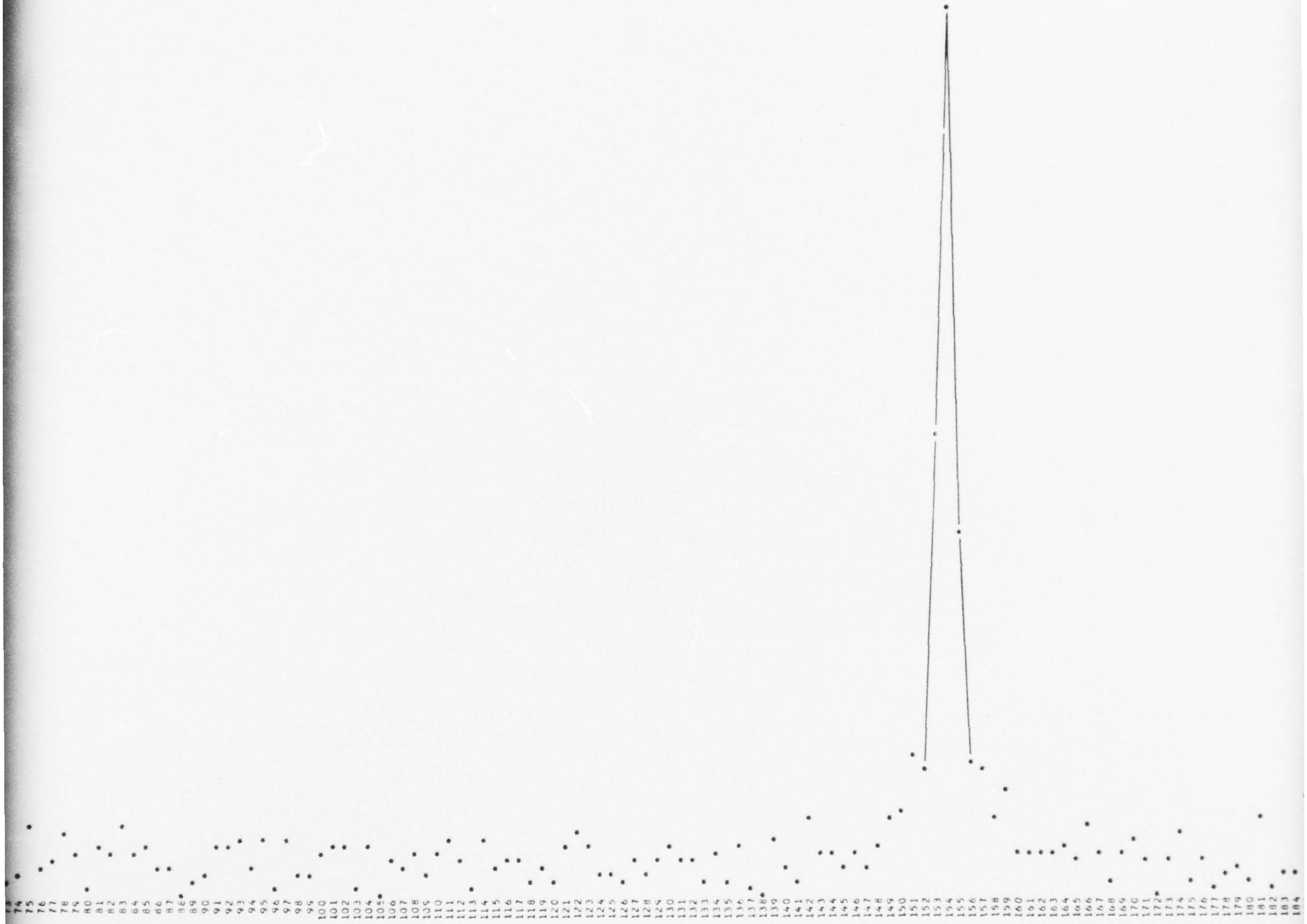
                                      T12 AVERAGE         = 0.9175
```

Fig. G-21 Histogram of First-Stage Edited Data Taken at Georgetown, DE; Data Segment 1

TOTAL DC POWER IN Q = 0.0133



2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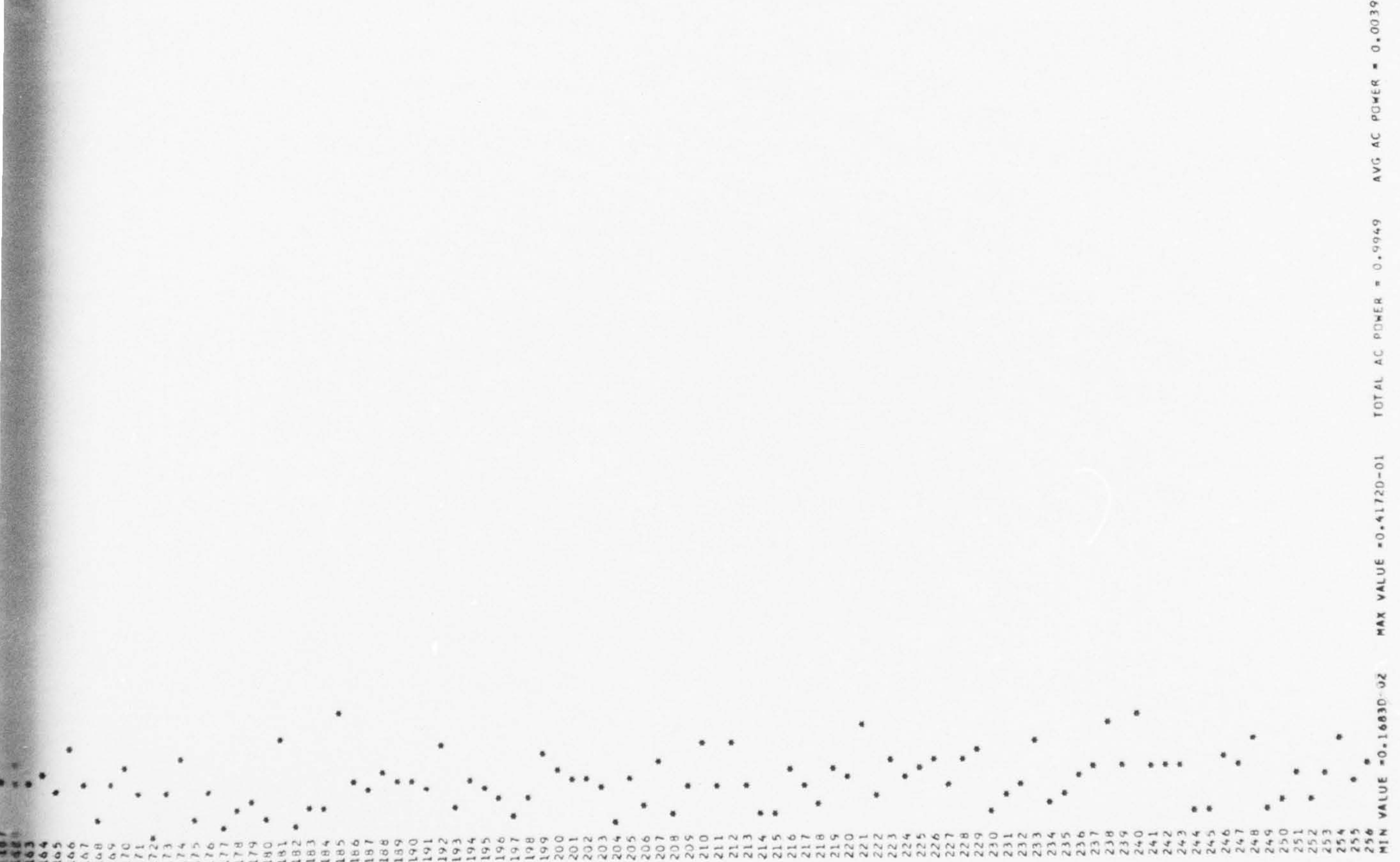

Fig. G-22 Power Spectral Density Showing Interference in Q Data Taken at Georgetown, DE; Data Segment 1

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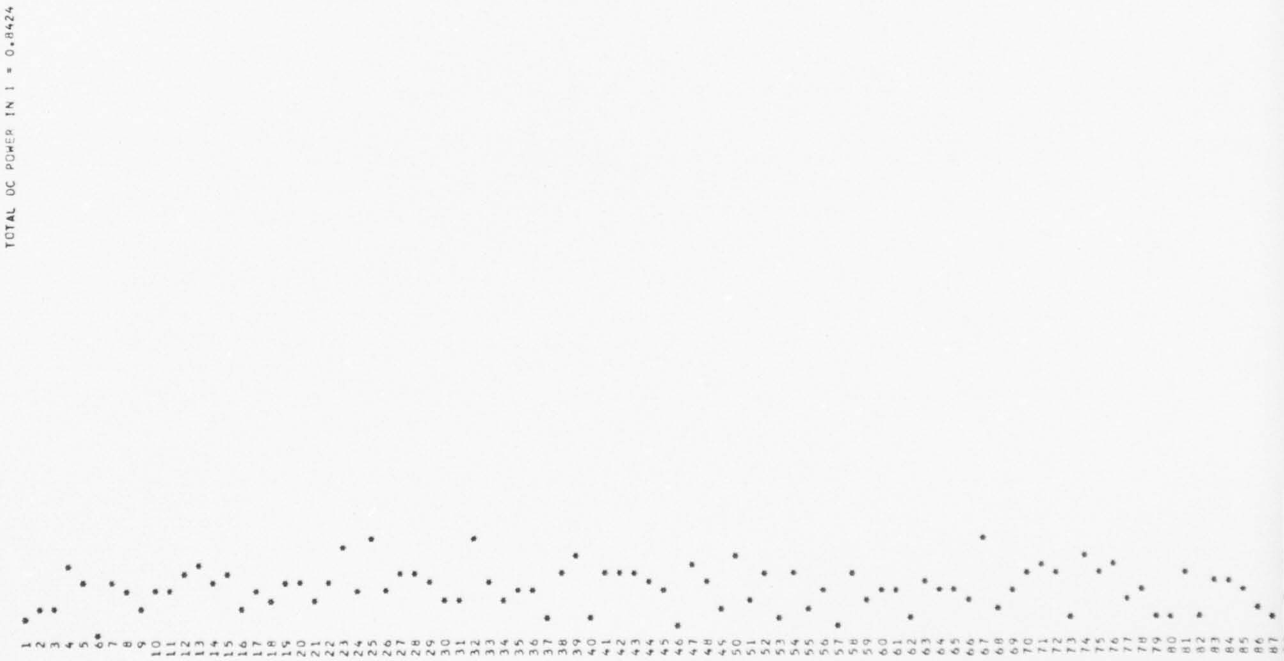
TOTAL DC POWER IN I = 0.8424

AD-A040 320 JOHNS HOPKINS UNIV LAUREL MD APPLIED PHYSICS LAB F/G 17/7
EXPERIMENTAL RESEARCH ON THE PROPAGATION OF LORAN-C SIGNALS. VO--ETC(U)
JAN 77 L F FEHLNER, T W JERARDI, T A MCCARTY N00017-72-C-4401
UNCLASSIFIED APL/JHU-TG-1298D NL

5 OF 5
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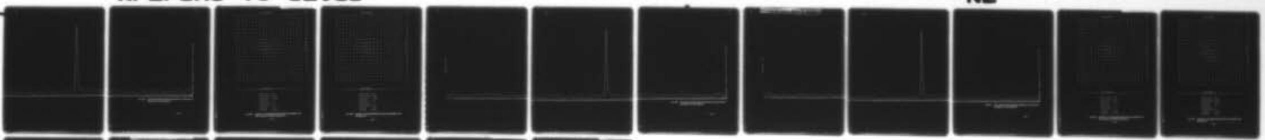

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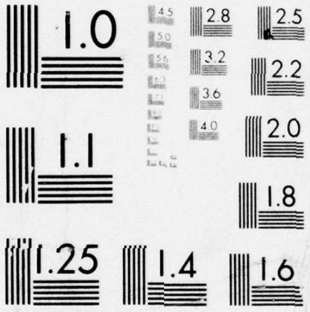
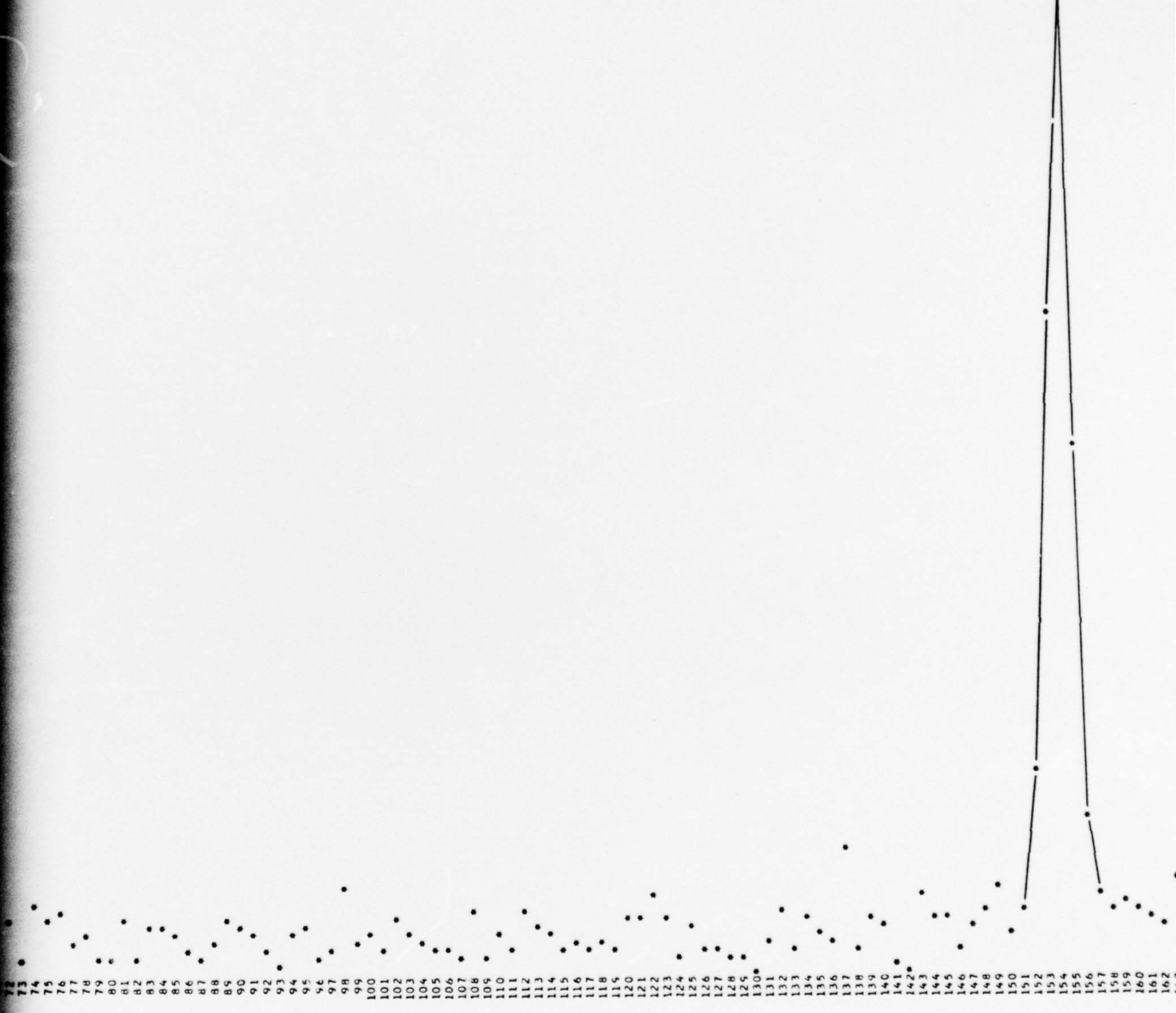


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

2



72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162

3

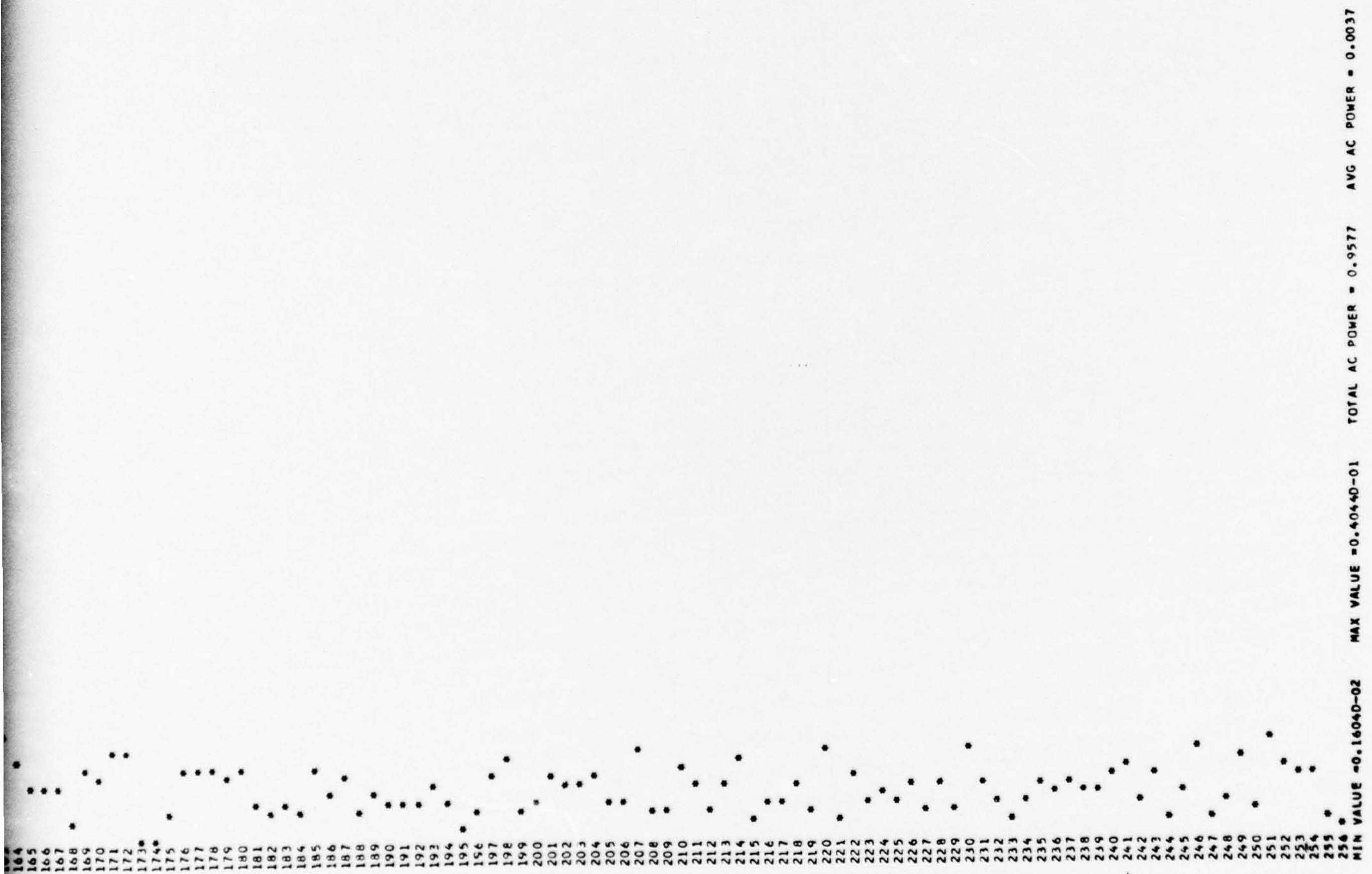


Fig. G-23 Power Spectral Density Showing Interference in I Data Taken at Georgetown, DE; Data Segment 1

```
                                        T11-T12 HISTOGRAM                                                   T11
  0    0    0    0    1    0    1    0    1    0    3    0    0    1    0    0    0    0    0    0            7
  0    0    0    0    0    0    0    0    0    1    1    1    0    0    0    0    0    1    0    0            4
  1    0    0    0    0    0    2    0    0    1    0    1    1    1    0    0    0    0    0    1            8
  0    0    0    0    1    1    0    0    0    1    2    1    1    0    0    1    0    0    0    0            8
  0    0    1    0    1    1    0    3    4    0    0    0    3    0    2    0    1    0    0    0           18
  0    0    0    1    0    1    3    2    5    5    3    3    2    2    1    0    0    0    0    1           29
  0    0    0    0    2    3    4    5   10    9    2    3    4    2    1    2    2    1    0    1           51
  0    0    1    1    5    4    5   12   29   29   42   20   10    4    1    0    2    1    0    1          167
  0    0    0    4    1    5    7   26  114  262  164   51   23    6    4    0    0    1    2    0          670
  0    1    0    1    2    5   13   44  334 1389 1035  164   34   10    3    5    3    1    0    1         3045
  0    0    3    1    3    4   12   29  159 1105 1435  274   34   10    8    2    0    2    0    0         3081
  0    1    0    0    1    4    9   17   47  182  311  133   24   11    4    4    1    1    0    0          750
  0    0    1    0    0    3    4    7   20   27   32   26   11    4    3    1    2    0    0    0          141
  0    0    0    0    1    1    1    5    6   12   12   18    3    4    1    0    1    1    1    0           67
  0    0    0    1    1    0    1    0    4    6    1    4    7    1    1    0    1    0    1    0           29
  0    0    0    1    0    1    0    0    1    1    1    3    1    1    1    1    0    0    0    0           12
  1    0    0    0    0    0    1    1    1    1    0    0    0    1    1    1    0    0    1    0            9
  0    0    0    0    0    0    1    0    3    0    0    0    1    0    1    0    0    0    0    0            6
  0    0    0    0    0    0    0    0    1    2    0    0    0    0    0    0    0    0    1    0            4
  0    0    0    0    0    0    0    0    0    0    0    0    0    1    0    1    0    1    1    0            4

                                        T12 DISTRIBUTION
  2    2    6   10   21   33   64  151  739 3033 3044  702  159   59   32   18   13   10    7    5

                        TOTAL NO. PAIRS      = 8192
                        T11,12 EDIT SIGMA    = 0.6249
                        EDITING LEVEL        = 6 SIGMA
                        T11 EDIT PAIRS       =  37
                        T12 EDIT PAIRS       =  35
                        T11,12 EDIT PAIRS    =  10
                        T11 AVERAGE          = 0.1046
                        T12 AVERAGE          = 0.9185
```

Fig. G-24 Histogram of First-Stage Edited Data Taken at Georgetown, DE, After Frequency Filtering; Data Segment 1

```
                                    T11-T12 HISTOGRAM                                       T11
   0    0    0    1    0    0    0    1    0    1    0    0    0    0    0    0    0    0    0    0        3

   0    0    0    0    0    0    0    1    1    1    0    1    0    0    1    0    0    0    0    0        5

   0    0    0    0    0    1    1    1    1    0    1    0    1    0    0    0    0    0    0    0        6

   0    1    1    1    1    1    0    1    3    1    2    0    0    1    0    0    0    0    0    0       13

   0    0    0    2    1    0    3    0    4    2    1    1    2    1    0    2    2    1    0    0       22

   0    0    1    0    2    1    2    3    1    4    4    5    1    0    0    1    0    0    1    0       26

   1    0    1    0    0    3    5    9    9   11   14    7    2    3    3    0    0    0    0    1       69

   0    1    1    0    2    1    8   25   42   55   33   15    9    4    2    1    1    0    0    1      201

   1    0    0    6    4    2   11   33  295  446  129   42   16   11    2    4    0    0    2    2     1006

   1    1    0    1    1    4   16   48  439 1355  768  145   29   13    4    4    0    0    0    2     2831

   0    0    0    1    1    6   12   26  134  662 1268  411   58    7    3    2    2    1    0    0     2594

   0    1    0    3    1    0    3   15   38  162  401  307   48   14    4    5    0    1    0    0     1003

   0    0    0    0    2    4    5    9   15   21   52   44   13    5    2    2    2    0    0    0      175

   0    0    0    1    1    2    4    4   10    7    6    8    9    4    3    1    0    0    1    0       61

   0    0    0    0    1    1    1    2    6    8    5    4    2    5    4    0    1    0    0    0       40

   0    1    0    1    2    1    1    0    0    1    4    5    1    1    0    0    0    0    1    0       19

   0    0    1    0    1    0    1    1    2    4    2    1    0    0    1    0    0    2    0    0       16

   0    0    1    0    0    1    1    1    1    1    0    0    0    3    1    0    1    0    0    0       11

   0    0    0    0    1    0    1    0    2    1    0    0    1    0    0    0    0    0    0    0        6

   0    0    1    0    0    0    1    0    0    0    2    0    0    0    1    0    0    0    0    0        5



                                    T12 DISTRIBUTION
   3    5    7   17   21   28   76  180 1003 2743 2692  996  192   72   31   22    9    5    5    6

                              TCTAL NO. PAIRS    = 8192

                              T11,12 EDIT SIGMA = 0.6575

                              ECITING LEVEL      = 6 SIGMA

                              T11 EDIT PAIRS     =  29

                              T12 EDIT PAIRS     =  39

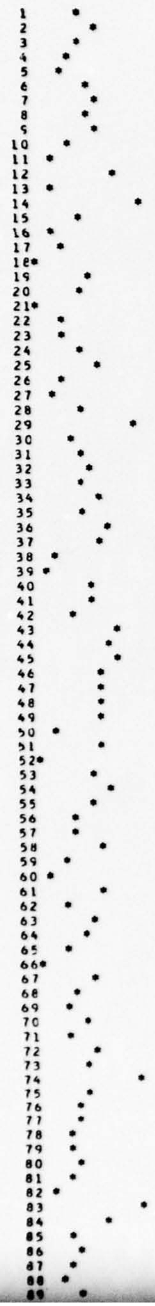
                              T11,12 EDIT PAIRS =  11

                              T11 AVEPAGE        = 0.0942

                              T12 AVERAGE        = 0.9173
```

Fig. G-25 Histogram of First-Stage Edited Data Taken at Georgetown, DE; Data Segment 2

TOTAL DC POWER IN Q = 0.0079



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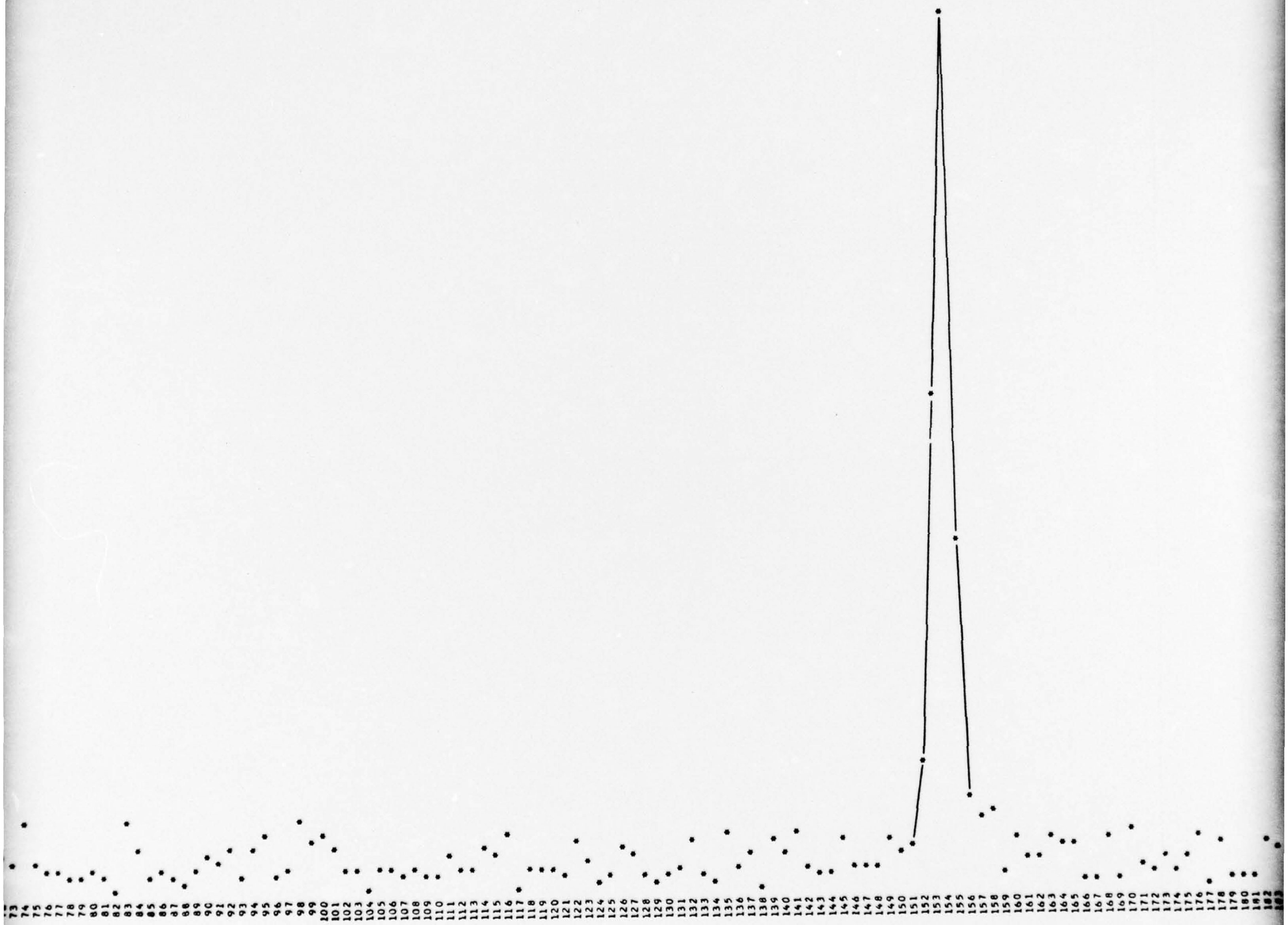
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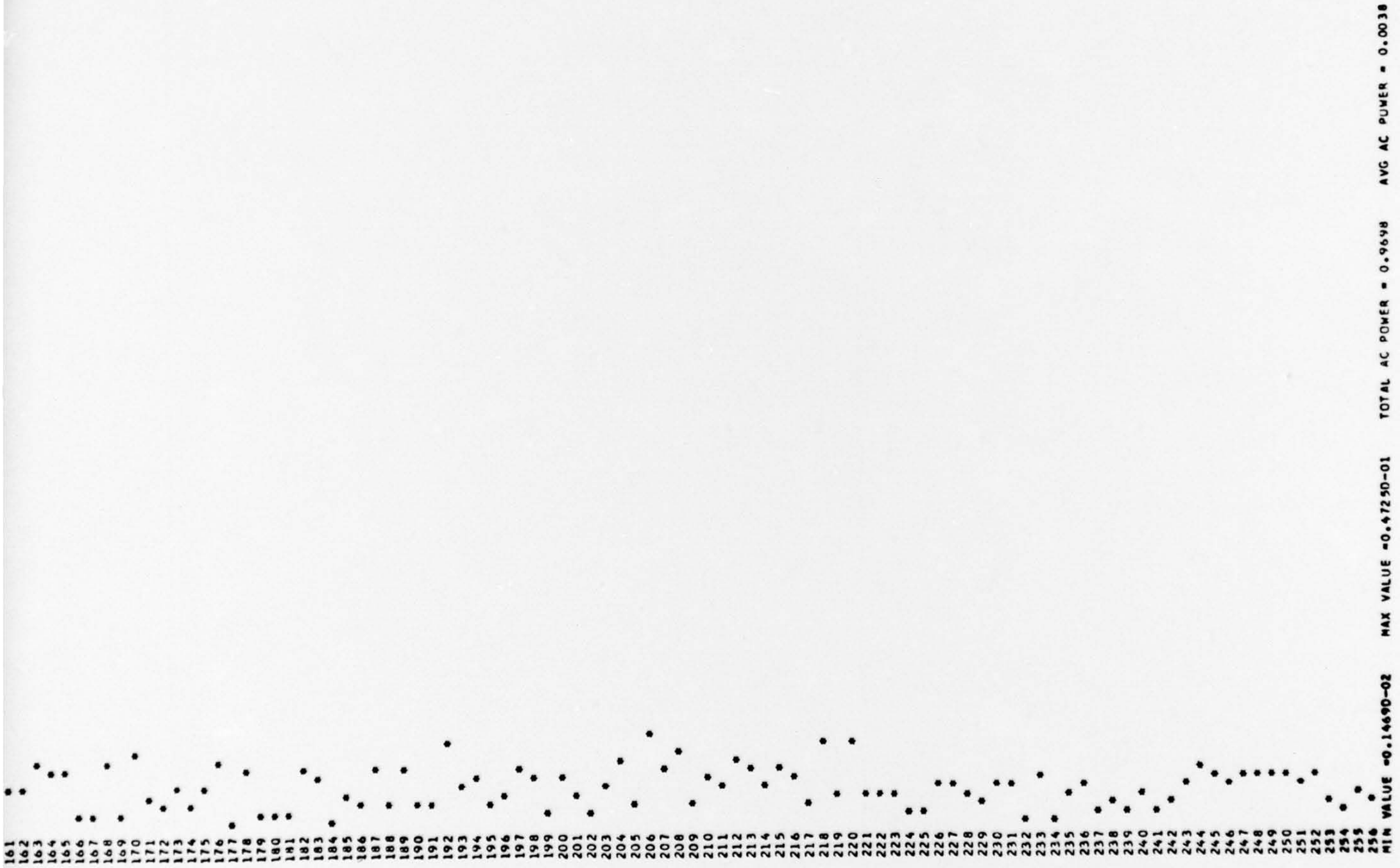
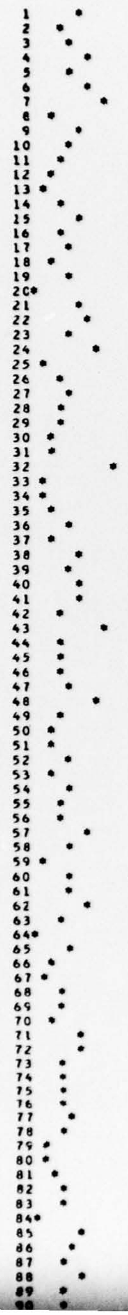


Fig. G-26 Power Spectral Density Showing Interference in Q Data Taken at Georgetown, DE; Data Segment 2

TOTAL DC POWER IN I = 0.8373



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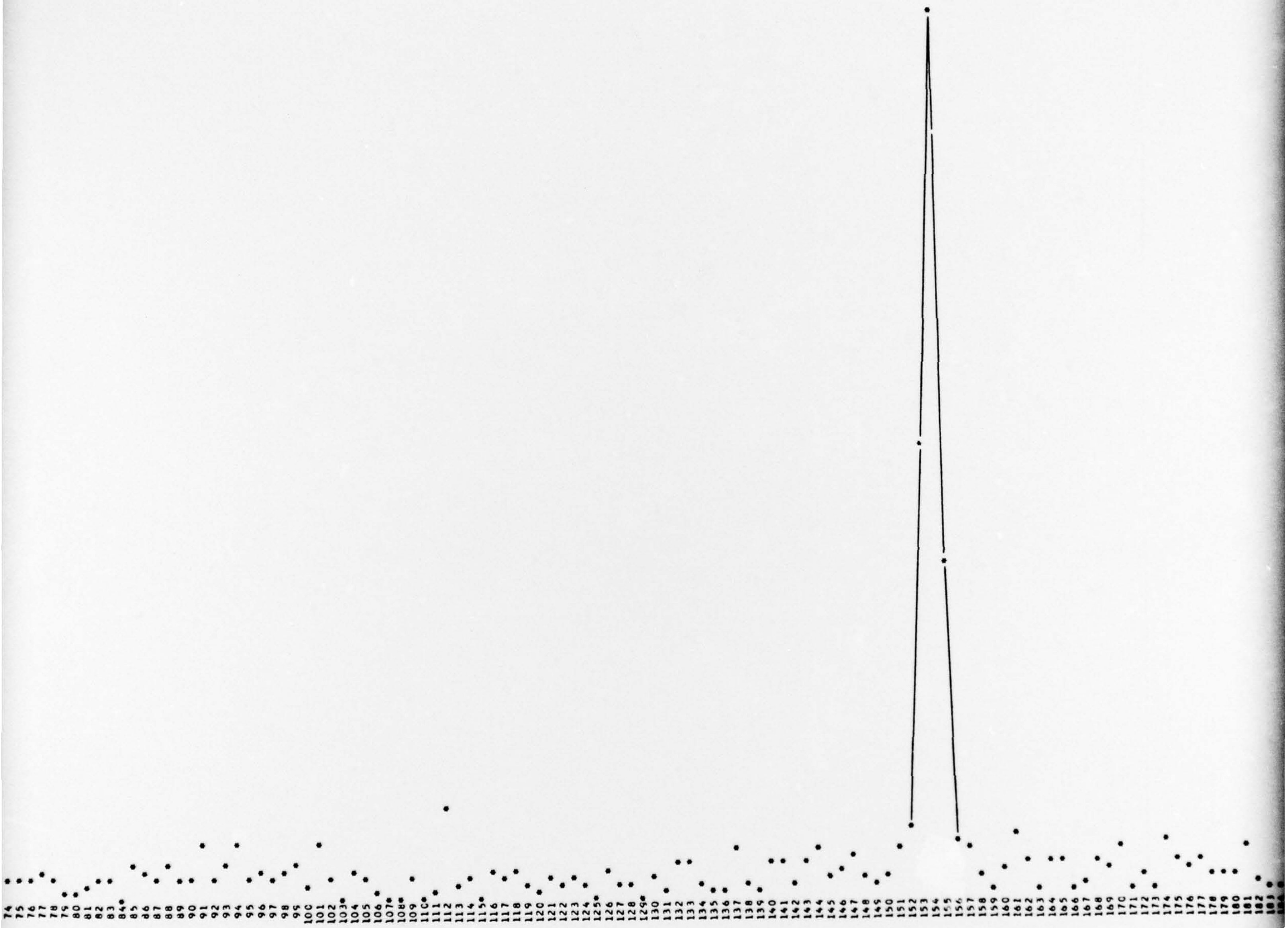
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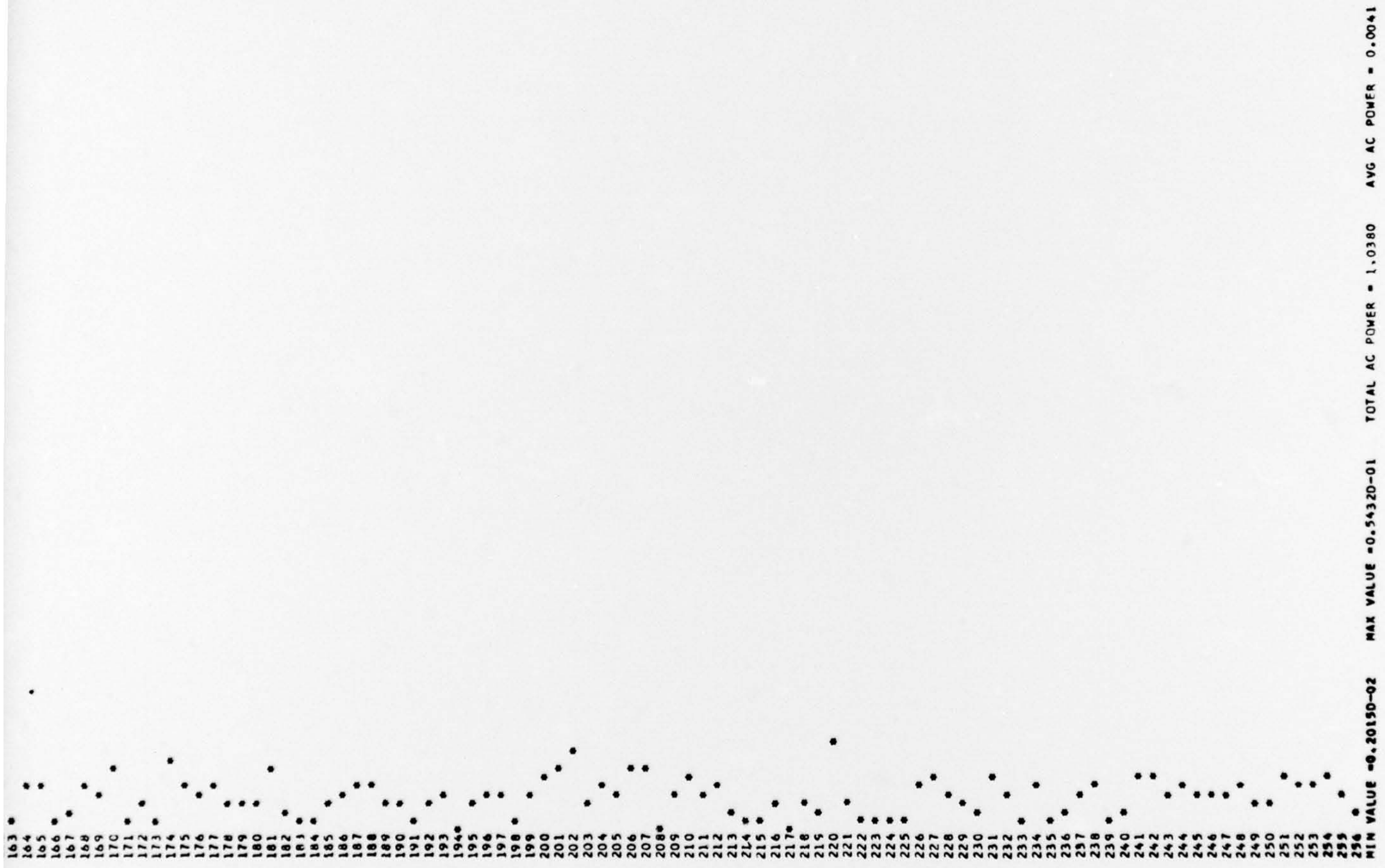


Fig. G-27 Power Spectral Density Showing Interference in I Data Taken at Georgetown, DE; Data Segment 2

```
                                     T11-T12 HISTOGRAM                                              T11

    0     0     0     1     0     0     0     0     0     0     2     1     0     0     0     0     0     0     0     0        4

    0     0     0     0     0     0     0     1     1     1     0     0     0     0     1     0     0     0     0     0        4

    0     1     0     0     0     1     0     3     0     1     0     0     0     0     0     0     0     0     0     1        7

    1     0     1     1     1     1     0     1     0     3     1     1     1     0     1     0     1     0     0     0       14

    0     0     0     1     2     0     1     1     7     4     1     1     1     1     0     1     0     0     1     0       22

    0     0     0     1     1     1     1     5     1     3     3     0     3     2     0     0     2     1     0     0       24

    0     1     0     1     0     1     2     8     7    11     8     6     6     3     1     1     0     0     1     0       57

    1     1     0     2     1     1     8    13    23    34    33    23     6     2     5     2     0     0     1     1      157

    1     0     0     1     0     2     8    28   117   304   167    46    22     8     7     1     1     0     1     2      716

    0     1     2     1    10     2    15    36   285  1485  1107   157    30     6     5     1     2     0     2     0     3147

    0     1     0     0     2     3     9    30   162  1025  1428   278    34    13     6     3     1     0     0     0     2995

    0     0     1     1     1     2     2    13    51   167   297   105    30    11     3     2     0     0     1     0      687

    0     0     0     1     0     4     3    16    15    25    27    25    10     4     3     2     0     1     0     0      136

    0     0     0     2     0     2     3     7    11     8     8    11     4     9     1     1     0     0     0     0       67

    1     0     0     0     2     0     1     3     3     1     8     4     0     4     0     0     1     0     0     0       28

    0     0     0     1     1     2     1     2     2     2     5     2     0     0     0     0     0     0     0     0       18

    0     0     1     0     1     0     2     0     3     1     0     0     2     1     1     1     1     1     1     0       16

    0     1     0     0     0     0     1     1     0     2     1     1     0     0     2     0     0     0     0     0        9

    0     0     0     0     1     0     1     0     2     0     1     0     0     0     0     0     0     0     0     1        6

    0     0     0     0     0     0     0     0     0     0     0     0     0     1     0     0     0     0     0     0        1



                                     T12 DISTRIBUTION
    4     6     5    14    23    22    58   168   690  3077  3097   661   149    65    36    15     9     3     8     5

                                     TOTAL NO. PAIRS    = 8192
                                     T11,12 EDIT SIGMA  = 0.6575
                                     EDITING LEVEL      = 6 SIGMA
                                     T11 EDIT PAIRS     =  33
                                     T12 EDIT PAIRS     =  35
                                     T11,12 EDIT PAIRS  =   9
                                     T11 AVERAGE        = 0.0966
                                     T12 AVERAGE        = 0.9176
```

Fig. G-28 Histogram of First-Stage Edited Data Taken at Georgetown, DE, After Frequency Filtering; Data Segment 2

```
                                  T11-T12 HISTOGRAM                                          T11
0   1   0   0   0   0   0   0   0   0   2   0   0   0   0   1   0   0   0   0                4

0   0   0   0   0   0   0   0   0   1   0   0   0   0   1   0   0   0   0   0                2

0   0   0   0   1   0   0   1   3   0   0   0   1   1   0   1   0   0   0   0                8

0   0   0   0   0   0   0   0   2   2   0   1   1   0   0   0   0   0   0   0                6

0   1   0   1   0   0   1   0   2   2   2   1   1   0   0   0   1   0   0   1               13

1   0   0   1   1   2   1   4   4   5   3   5   2   2   1   1   0   0   0   0               33

0   0   0   2   2   1   5  10   9   8   8  11   5   4   0   1   0   1   0   0               67

0   0   0   0   4   3   5  19  59  64  36  13   6   3   2   0   2   0   1   0              217

0   0   0   2   1   8   9  53 330 481 137  48  15   9   3   0   1   1   0   0             1098

0   1   3   1   3   1   7  41 416 1189 817 176 24  11   5   3   2   1   0   0             2701

2   1   0   4   2   1  10  32 151 750 1158 437 52  11   4   0   0   0   0   1             2616

0   1   0   0   1   5   7  17  41 152 430 287  51  13   5   1   1   2   0   0             1014

0   0   0   4   4   1   3   7  16  40  43  56  22   3   2   3   0   1   0   0              205

1   0   0   0   3   0   4   2   3  12  11   9  10   3   1   0   3   0   0   0               62

0   0   1   0   1   0   0   2   2   7   8   5   3   5   3   2   0   0   0   0               39

0   0   1   0   1   1   2   1   0   1   4   4   2   2   2   1   0   0   0   0               22

0   0   0   0   0   0   1   1   1   0   1   1   1   1   1   0   0   0   0   0                8

0   0   0   0   0   0   1   0   2   1   1   2   0   1   2   0   0   0   1   0               11

0   0   1   1   0   1   0   0   0   0   0   0   0   0   0   1   1   0   0   0                5

1   0   0   0   0   0   0   0   0   0   0   1   0   0   0   0   0   1   0   0                3

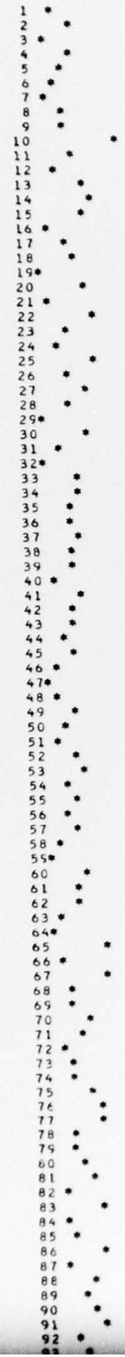


                                  T12 DISTRIBUTION
5   5   6  16  24  24  56 150 1041 2715 2661 1057 196  69  32  14  11   8   2   2

                         TOTAL NO. PAIRS    = 8192
                         T11,12 EDIT SIGMA  = 0.6278
                         EDITING LEVEL      = 6 SIGMA
                         T11 EDIT PAIRS     =  25
                         T12 EDIT PAIRS     =  19
                         T11,12 EDIT PAIRS  =  14
                         T11 AVERAGE        = 0.0976
                         T12 AVERAGE        = 0.9247
```

Fig. G-29 Histogram of First-Stage Edited Data Taken at Georgetown, DE; Data Segment 3

TOTAL DC POWER IN Q = 0.0085



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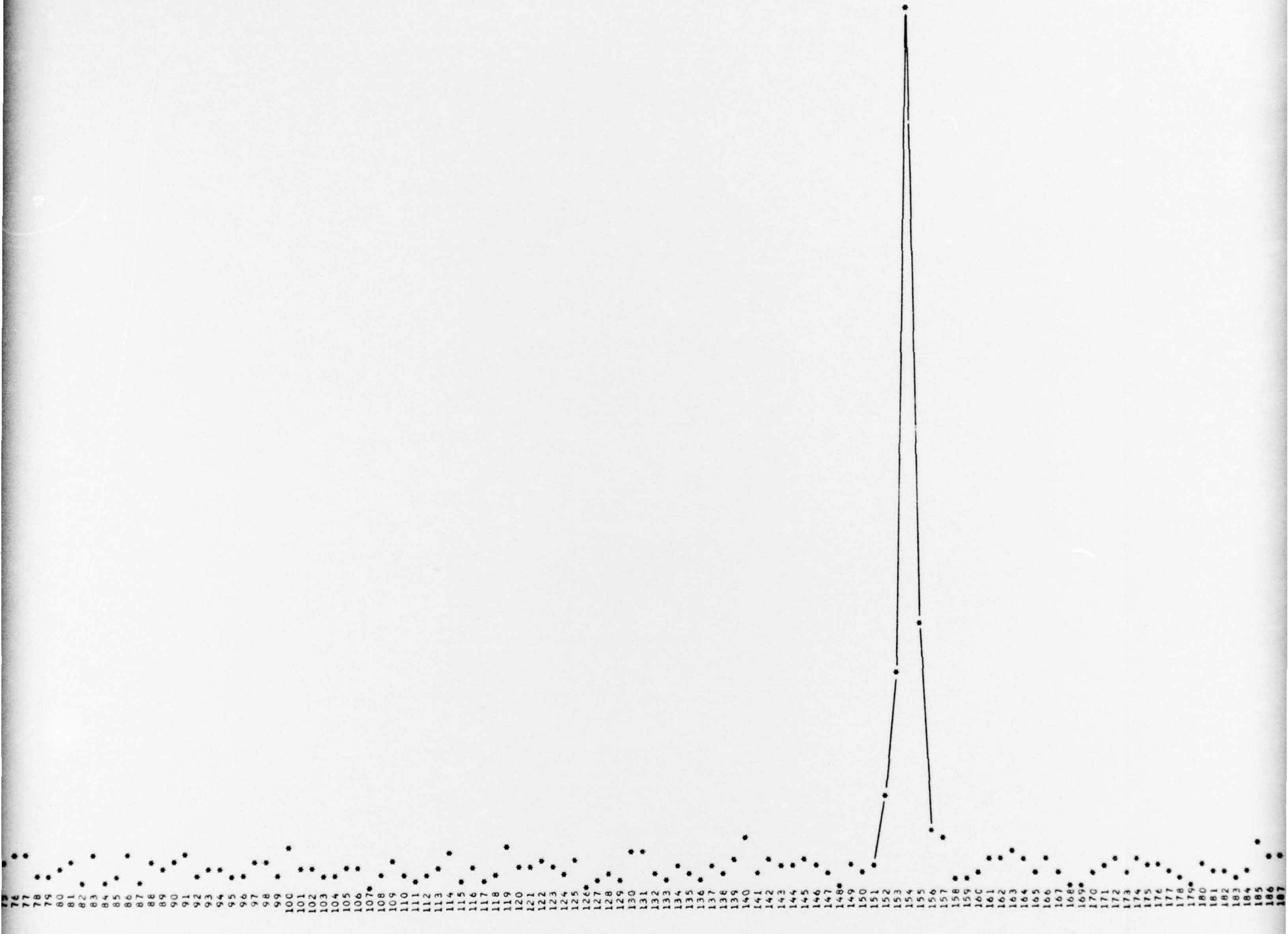
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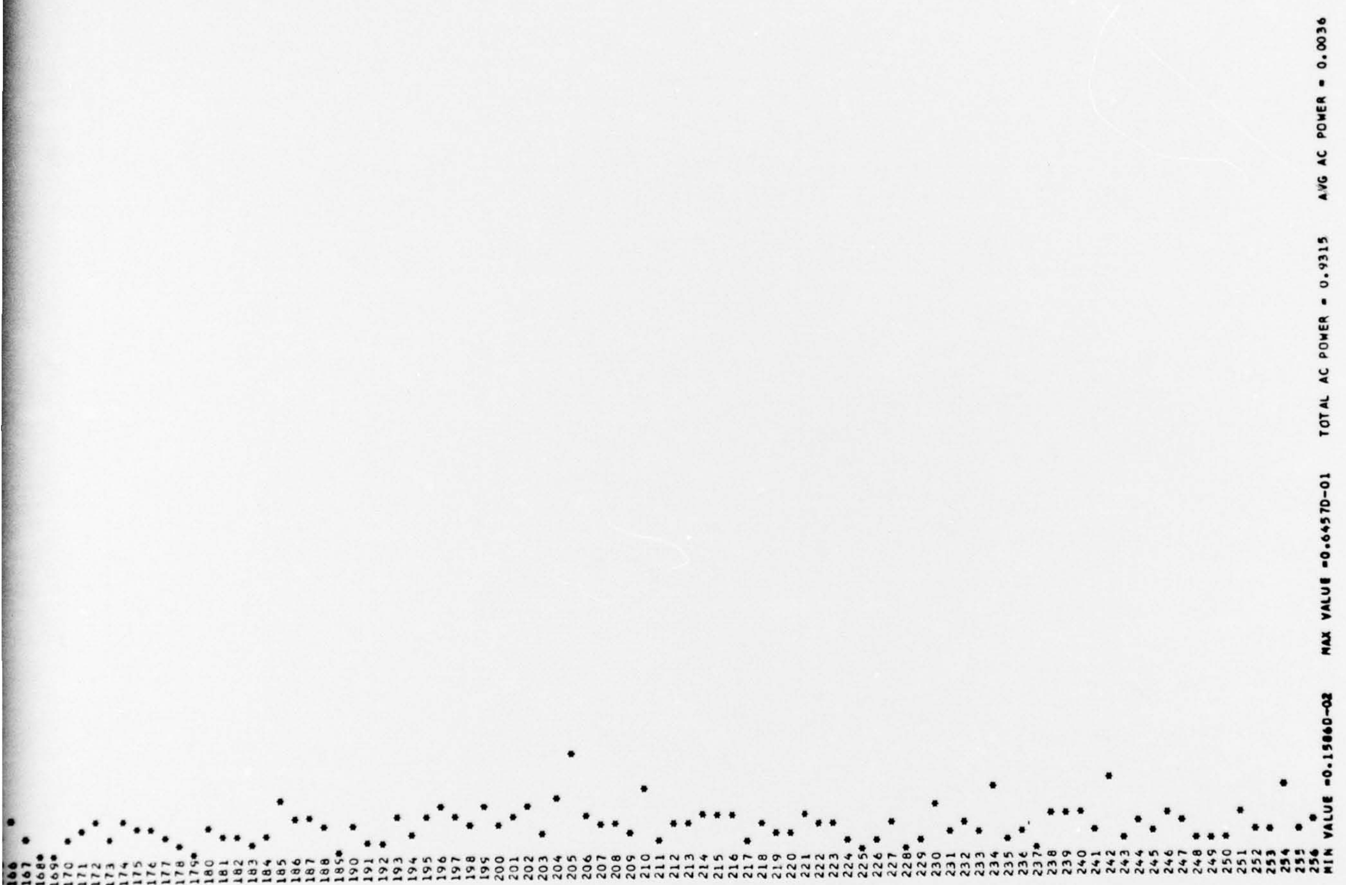
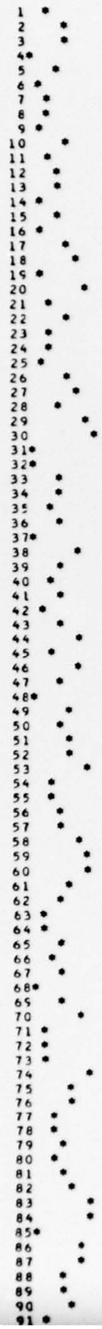


Fig. G-30 Power Spectral Density Showing Interference in Q Data Taken at Georgetown, DE; Data Segment 3

TOTAL DC POWER IN I = 0.8568



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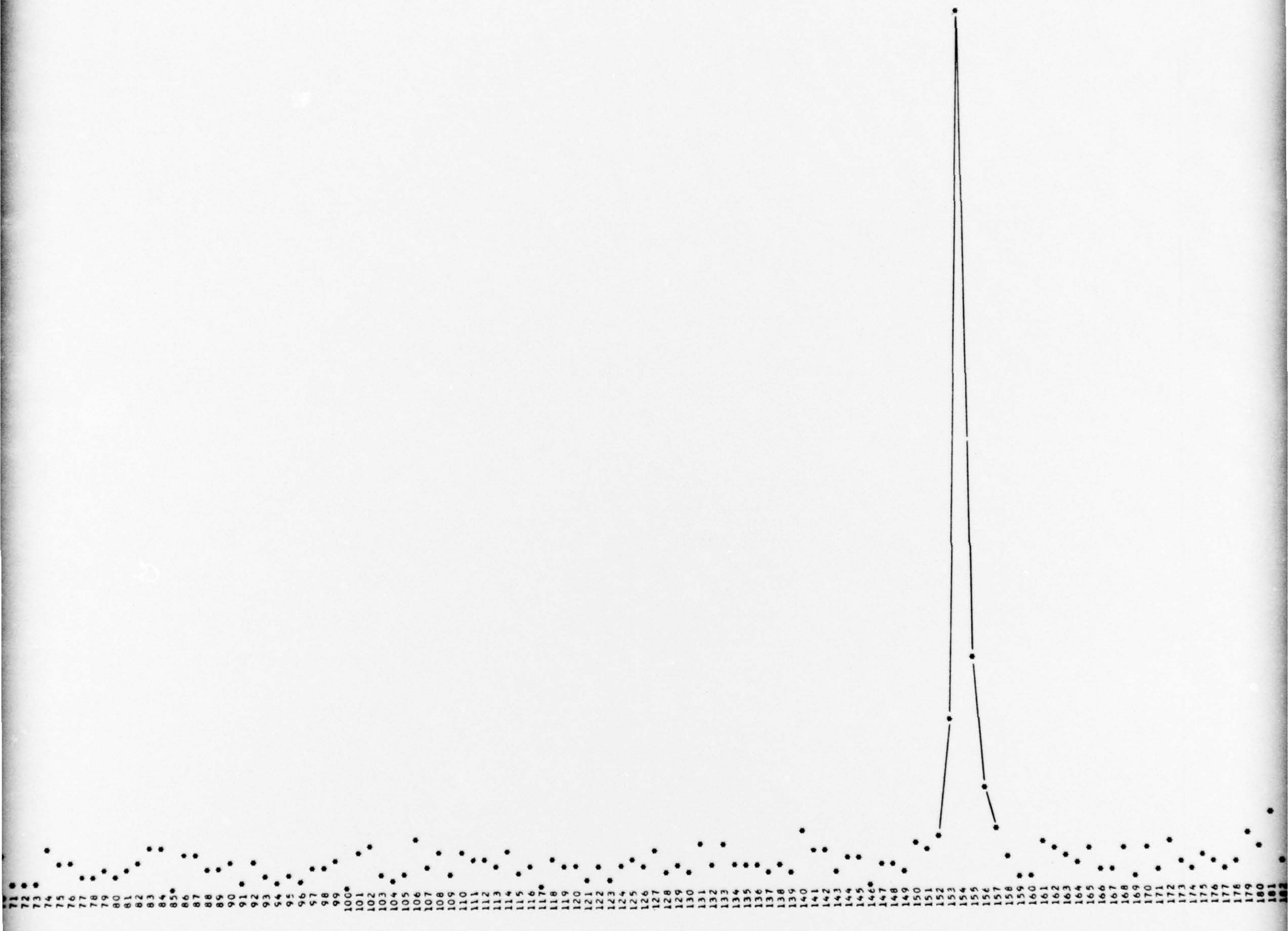
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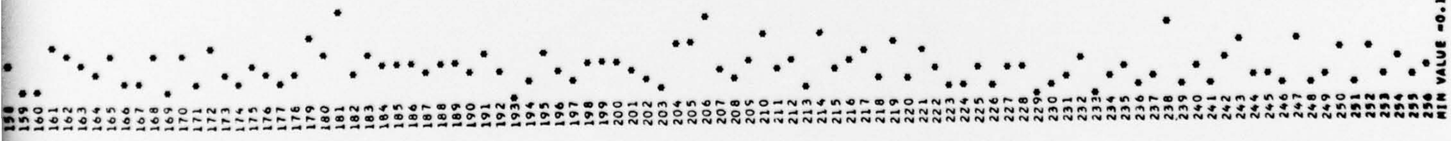

Fig. G-31 Power Spectral Density Showing Interference in I Data Taken at Georgetown, DE; Data Segment 3

```
                                        T11-T12 HISTOGRAM                                          T11
  0    0    0    0    0    0    0    0    0    0    1    1    0    0    1    0    0    0    0    0      3

  0    1    0    0    0    0    0    0    1    0    2    1    0    0    1    0    0    0    0    0      6

  0    0    0    1    0    0    0    1    0    2    0    0    0    0    1    0    0    0    0    0      5

  0    0    0    0    0    0    0    0    1    3    2    1    0    1    0    0    0    0    0    0      8

  1    0    0    1    1    0    1    0    1    2    1    3    0    1    1    0    0    0    0    0     13

  0    0    1    0    1    0    0    3    7    2    1    2    2    3    0    0    1    0    0    1     24

  0    1    0    1    2    0    4    8   10   11    6    6    2    2    2    1    0    1    0    1     58

  0    0    0    0    4    2    5    9   27   42   34   20   10    5    2    1    1    0    0    1    163

  1    2    0    0    1    6    6   23  154  330  173   51   13   11    4    0    0    2    0    0    777

  0    1    1    0    3    2    9   25  298 1416 1137  197   30    8    5    1    2    1    0    0   3136

  0    0    1    4    4    4    8   29  170 1008 1344  295   27   14    4    0    1    1    0    1   2915

  0    1    0    3    1    1    5   18   57  182  303  132   24    8    6    3    0    2    0    0    746

  0    0    0    3    1    3    5   11   16   33   37   19   12    3    0    1    0    1    0    0    145

  0    1    0    2    0    1    1    3    5   10   15   12    5    3    1    1    2    0    0    0     62

  0    0    0    1    1    2    0    1    5    1    9    4    3    4    1    1    0    0    0    0     33

  0    0    1    0    0    0    2    1    1    2    1    2    1    3    0    1    1    0    0    0     16

  0    0    1    0    0    1    1    1    1    1    0    3    0    2    1    0    0    0    0    0     12

  0    0    0    0    0    0    0    0    1    0    2    1    0    2    0    0    0    0    1    0      7

  1    0    0    1    0    0    0    0    0    0    1    0    0    0    0    0    2    1    0    0      6

  0    0    0    1    0    1    0    0    0    0    1    0    0    0    0    0    0    0    0    0      3



                                        T12 DISTRIBUTION
  3    7    5   18   19   23   47  133  755 3045 3070  750  129   70   30   10   10    9    1    4

                                   TCTAL NO. PAIRS    = 8192
                                   T11,12 EDIT SIGMA = 0.6278
                                   ECITING LEVEL      = 6 SIGMA
                                   T11 EDIT PAIRS     =  22
                                   T12 EDIT PAIRS     =  18
                                   T11,12 EDIT PAIRS =  14
                                   T11 AVERAGE        = 0.0984
                                   T12 AVERAGE        = 0.9253
```

Fig. G-32 Histogram of First-Stage Edited Data Taken at Georgetown, DE, After Frequency Filtering; Data Segment 3

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		W. Schor	1
		E. Bregstone	1
USCG/G-EAE-4/63, HQ	Washington, DC 20590	R. Wehr	1
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